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ELECTRICAL GROWTH.

One evidence of the rapid development of the electrical field has been the growth of the American Institute of Electrical Engineers. In membership it is now the premier national engineering body in America, although the youngest. According to the figures presented by Mr. Martin before the Schenectady chapter of the Institute, the Electricals have over 5000 members, the Civils about 4400, Mechanicals 3335 and Mining 4179—the last two being for October. The maintained rate of growth seems to be higher in the Electrical Engineers, but it will be interesting to compare these figures with those of 1917. Meantime here is a splendid total enrollment of 17,000 engineers, in the four national bodies, with an infinite potentiality of usefulness.

FUTURE OF LAND WIRES.

The use that is being made of the Marconi wireless telegraph service by the *New York Times* is a splendid example of well-directed journalistic enterprise. Column after column of news is given from this source, and thus the basis is laid for a tremendous extension of the same service, both for press work and for commercial messages. But when our contemporary says "there is little doubt that the use of land wires will eventually be dispensed with," we fail to follow it. If it means to concede that there will still be ocean cables, we can agree with it heartily, yet it is over the sea that the wireless has its best chance of success. When it comes to land lines, the wireless depends heavily on such lines, and has not yet shown itself able to deal with even some of the rudimentary problems of regular long-distance land service. The land lines will be with us for many years to come. But we can get along with fewer of them. What is needed is the adoption of automatic and rapid systems of transmission that will enable one wire to do the work of several, better and cheaper than it is now done by poorly-paid manual operators, who constitute one of the greatest anachronisms of modern electrical development.

AN ALTERNATOR WITH A COILLESS ARMATURE.

An article by Messrs Punga and Hess on page 962 directs attention to the conditions under which an e. m. f. may be produced in the shaft of revolving-field machines. That such an e. m. f. could exist and not be noticed in machines in regular service is attributable to the small value of the e. m. f. and to the good insulating qualities of the films of oil in the bearings. Only when there exists a dissymmetry of the magnetic circuits such as is seldom found in practice, does the shaft e. m. f. reach a value sufficient to produce appreciable current in the bearings. As pointed out by the authors, the shaft e. m. f. may be entirely eliminated by making the reluctance of the magnetic path symmetrical with reference to the field magnets. An interesting feature of the article is the discussion of the excitation characteristics and the voltage regulation of a generator whose only active e. m. f. is that produced in the shaft by reason of the dissymmetry of the magnetic circuit. The authors find that there must be an enormous difference between

the reluctance of the several main magnetic paths through the stator if the rotor e. m. f. is to reach a desirable value at a moderately high speed, and the e. m. f. is to be maintained reasonably constant under a suitable rating of full-load current. However, the construction of an alternator with a coilless armature is shown to be readily possible for a rating of 30 volts and 8000 amperes. The low value of the e. m. f. of such a machine would not prove objectionable, provided the machine possessed sufficient compensating advantages. The machine proposed resembles in certain of its operating characteristics an alternator of the "inductor" type, while in its constructive details it is not unlike a "unipolar" direct-current generator without copper on the rotor. It would probably possess the poor regulation of the former machine and the low efficiency of the latter.

Keeping Down the Peak.

It has been suggested that illuminating engineering furnishes an admirable means for keping down central-station peak loads. It is one of the fundamental principles of sound central-station business policy that the ratio of the peak to the average load be kept as low as possible; or, in other words, that the load factor be kept high. Certain classes of business which use energy many hours per day yield enough revenue to the central-station company to pay for operating expenses and the fixed charges on the investment necessary to serve them. Customers using energy only a short time per day are an unprofitable class, provided their demand comes at the time of peak load. In order to keep down the demand of this unprofitable class of business, which comprises mainly stores and offices which close early, it is proposed that the central-station company shall attempt to engineer such customers' installations so that they will get satisfactory lighting with the smallest possible demands, thus aiding to keep down the unprofitable portion of the central-station company's investment. While this may seem like rather finely spun theory, it undoubtedly indicates a wise line of policy for a central-station company to pursue. It is not to be expected that the pursuance of such a policy will work any great changes in the company's load factor for several years, but the load factor of every central-station company certainly needs helping; and it is only by combining all the slight possible improvements that any change worth while can be accomplished.

High-Speed Direct-Current Generators.

Generators of any type arranged for direct connection to steam turbines require great care in design from mechanical considerations, on account of the high centrifugal force. In alternators a solution for the problems encountered is found in placing the armature winding on the stator, where it will be free from mechanical stresses. It is evident at once that the design would be more difficult if the designer were forced to place the armature winding on the rotor. The difficulty reaches a maximum when he must place on the rotor not only an armature winding, but also a many-part commutator, and must so arrange the latter with reference to the former and to the stationary field winding that no sparking is produced at the brushes. Solutions of the many electrical and mechanical problems thus involved in the design of direct-current turbo-generators form the subject of an article by Mr. H. I. C. Beyer on page 964 of this issue. The machine described in detail by Mr. Beyer is provided with a cylindrical commutator held in place by shrink-rings, a type of construction that has proved well suited to high-speed operation. The armature winding proper differs from the type employed with low-speed machines in that each conductor is formed in two parts so that use may be made of partially-closed slots, and the winding may be bound into place as a mass integral with the armature core. The field winding consists of shunt-connected coils for producing the main excitation, series-connected coils for increasing the e. m. f. with increase in load, distributed series-connected coils for preventing field distortion by the armature m. m. f., and concentrated series-connected coils for perfecting the commutation. Probably the most interesting feature of the article is that dealing with the proportioning of the latter coils. The author considers that since a conductor in which the current will be reversed during the commutation period is surrounded by a "reactance flux" of a certain value in one direction just previous to commutation, and surrounded by an equal flux in an opposite direction immediately after commutation, the "reactive" e. m. f. may be completely neutralized by causing this same conductor, during the commutation period, to cut across a stationary flux equal in value to double the "reactance flux." The improved commutation observed when combined carbon and copper brushes are substituted for copper brushes he attributes, in part at least, to the increased arc of brush contact; that is, to the lengthened period of commutation and increased stationary flux cut during this period. That is to say, the added contact resistance of the carbon brush need not be depended upon for perfect commutation, provided the commutating field bears the proper relation to the "reactance flux."

Effects of Short-Circuits on Watt-Hour Meters.

Nearly all modern watt-hour meters are little electromagnetic motor-devices, directly coupled to disc magneto-generators operating on short-circuit. This provides a frictionless load, in which the resisting torque is automatically rendered proportional to the speed of rotation. The disc is usually composed of copper, and runs between the poles of permanent magnets. The constancy of calibration of the meter depends, among other things, upon the permanence of the magnetism in these drag-magnets. If they should increase in magnetic strength, their torque per unit rate of disc rotation would likewise increase, and the device would tend to underregister. If, on the contrary, they should depreciate magnetically with age, their torque on the disc rotating at given speed would diminish and the device would speed up accordingly, and over-indicate. In the first case the monthly meter bills tend to be too small, or the error goes against the company; in the second case, the bills tend slightly to increase, or the error goes against the consumer. When a sudden great excess of current passes through the series coils of motor-meters, as in the case of a momentary short-circuit on the consumer's mains, the series coils become momentary powerful electromagnets that are capable of disturbing the magnetic condition of the permanent drag-magnets. It is well-known to central-station meter men that such short-circuits are liable to affect the calibration of a meter. It has been generally supposed that if the magnetic axis of the series coils stood at right-angles in the horizontal plane, to the lengths of the drag-magnets, the magnetic disturbance due to an accidental short-circuit current was minimized.

In an article published on page 969 of this unmber, Prof. A. A. Radtke describes some experiments which he made with

an actual watt-hour meter when fitted with certain auxiliary series coils. A conclusion drawn from these experiments is that when the series coils act along the direction of the drag-magnets, a sufficiently intense excitation of these coils always increases the strength of the magnets. Although that may have been the actual result produced in the tests described, it would perhaps be unsafe to generalize the conclusion and assume that this result must always follow with either direction of short-circuit current, or with all geometrical dispositions of the essential parts. In the case described by the article, the magnetic force from the violently excited series coil acts along the two sides of the drag-magnet, aiding or reinforcing the magnetization on one side, and opposing or weakening the magnetization on the other. But the magnetic force so exerted will be greater on the side lying nearer to the series coil, and the difference between the two magnetic forces acting on the respective sides will depend on the shape of the permanent magnet and on its proximity to the disturbing coil. It may be a fact that when half a permanent magnet is strengthened and the other half weakened by the simultaneous momentary action of the same intensity of magnetic force, the resultant effect is to strengthen the magnet. Even this seems an unsafely wide generalization that should be carefully checked experimentally; but when the two simultaneously acting magnetic forces are not symmetrical, the conclusion seems open to much uncertainty. Nevertheless, the experiments recited in the article are valuable as showing that the generally accepted notions on this matter are unreliable, and that the possible effects of short-circuit currents on meter calibration should be carefully investigated.

STUDIES ON THE METALLIC ARC.

A recent paper by Cady and Arnold, which is abstracted in the Digest, throws some new light on the behavior of the arc between metallic terminals. The subject is now of some commercial importance since the so-called luminous arcs worked at low current values are steadily coming into use. The especial point of the paper under discussion is the study devoted to the critical conditions of stability when the current is near its minimum practical value. The arc drawn between iron terminals, for instance, passes through two well-defined stages, to lay aside minor considerations. In the first, the cathode is the chief source of activity and the phenomena near the anode are comparatively insignificant. The arc is stable, it is true, but far from brilliant, and existing chiefly as a cathode glow. This condition is preserved quite steadily until the current is pushed up above a certain value, fairly definite for each given arc. Then the arc suddenly reaches over and involves the anode, the potential difference falls about 12 volts and the arc becomes powerfully luminous. The change is in some respects analogous to that connected with the hissing state of the carbon arc, but differs greatly in its practical significance. For in case of the iron arc the running condition must always be, for any sort of efficiency, the second stage just mentioned, and the small currents employed in such arcs are likely to involve conditions which may come perilously near to causing a shift to the first stage.

Cady and Arnold made a critical examination of the causes leading to the sudden change from the first to the second stage, and after very ingeniously eliminating various possibilities, have shown in effect the critical point is that at which the active vaporization of the anode begins. In other words, during the first stage the arc is due to cathodic radiation and continues steadily enough until the heat becomes sufficient to furnish vapor from the anode. Then the transition fall of potential between the integral metal of the anode and the surrounding hot gases merges into the new phenomenon of a true vapor stream, and the arc assumes its normal luminous condition. The close connection of the first stage with the cathode glow in a Geissler tube is indicated by the fact that under proper conditions one may get with metallic arcs the striæ often found in Geissler tubes. Moreover, at very low values of the current there was noted a preliminary state quite corresponding to the weaker stages of the Geissler tube excitation, in which the visible phenomena are limited to a fairly distinct cathode glow and a weak anode glow. Many of the experiments were carried on in an atmosphere of nitrogen, which eliminates the secondary phenomena due to excitation, especially conspicuous in the carbon arc and associated with the hissing state. In the case of most metals the critical point between the first and second stages of the arc is not well shown in free air owing to these secondary effects. Iron and copper, the metals most used commercially, show it best, owing chiefly to their high vaporizing points. Evidently a volatile constituent would tend to remove the critical point by providing the needful vapor bridge at low current values. Volatile metals like lead and silver could be coaxed into showing a distinct first stage only in nitrogen at reduced pressure.

Experiments of this sort are seldom lacking in practical value, and in this instance their value is apparent in their bearing upon the new arcs. They show plainly that with iron or copper terminals of similarly high vaporizing temperature, the critical point is, especially with a fairly long arc such as is desirable for the proper distribution of light, somewhat dangerously near the currents actually used. Two and three-ampere arcs are being seriously considered, and the tendency is towards such low currents. For an iron arc the critical current for an arc of commercial length is nearly one and one-half amperes, and very small disturbances on the circuits or very moderate drafts are competent either to put the arc wholly out of business or to degrade it into a useless stage. One can blow out a three-ampere arc between iron terminals more easily than a candle. A very small disturbance breaks the continuity of the vapor stream and sends the arc into the glow condition, even if it is not broken entirely. In short, one is working with some of these recent arc lamps in the limiting region near to impracticability. A larger current or more vaporizeable electrode is very desirable in the interests of stable working. The former recourse seems the more desirable, since easy vaporization means more rapid waste and more objectionable débris to dispose of. Raising the current will not escape the waste and débris, but it at least gives one a system less disturbed by trivial grounds and a somewhat better range of materials with which to work. There are limits to the subdivision of the electric arc even with metallic electrodes, and they cannot be escaped. Incidentally, Cady and Arnold found even above the critical point some very singular conditions of instability, with rotation of the arc and other curious phenomena. The subject is one that needs further investigation; for in changing the electrodes from carbon to iron it is clear that new conditions come to the front which the older experiments on the arc do not adequately meet.

Prohibiting an Increase of Capitalization.

An important decision has been given by the New York Public Service Commission of the Second District, against a proposed increase of capital. The decision permits a new corporation, the Lockport Light, Heat & Power Company, to purchase the Lockport Gas & Electric Company and its rival, the Economy Light, Fuel & Power Company, of Lockport. But it forbids the new company, however, to issue securities for a capitalization above $700,000, equivalent to the total issues of the two old companies. The new company desired to issue stock and bonds to a total of $1,200,000. The decision also makes it plain that increases of the price of gas and electricity will not be permitted to follow the combination of competitive companies. The companies have been engaged, as is well known, in a bitter war in Lockport, as a result of which the prices of energy for lamps and motors in that city are lower than in most cities, and below cost, it is claimed. The combination was planned to put an end to the war.

The merger clause of the new law prohibits the issue of securities of such a corporation to an amount exceeding the total of those of the corporations merged. The new Lockport Company asserted that it was not a merger, but a new corporation, and therefore was not subject to this provision. Its application to do business was opposed by the city of Lockport and by the Attorney General. The city objected to the increased capitalization, and held that the elimination of competition would result in increased charges. The Attorney-General declared that the promoters proposed the formation of a monopoly in contravention of the statutes of the State.

"Technically speaking," says the commission, "the case in question is neither a consolidation nor a merger, but the purchase by a newly-formed corporation of the property and franchises of two existing companies. It will be observed, also, that the prohibition of the statute is confined to an increase in a merger or consolidation of 'capital stock,' and such prohibition does not expressly apply to increase of bonded indebtedness.

"The purpose behind the statute, however, is perfectly clear. The provision of law in question is designed to prevent those large increases of capital issues which have so often accompanied the consolidation of public service corporations in the past, and which have imposed heavy burdens upon municipalities in the way of inadequate service and excessive prices through the endeavor by the overcapitalized company to earn interest and dividends on the excessive issue of securities If this beneficent purpose of the statute can be evaded simply by effecting consolidation in fact through the form of a newly organized purchasing company, without technical merger or consolidation of the existing companies, or if it can be evaded by leaving the aggregate capital stock unchanged, but imposing the same burden upon the community through a greatly increased issue of bonds, the statute totally fails to accomplish the intended purpose.

"We think it quite clear that the policy of this commission, in case two or more gas or electric companies in any community are permitted to sell out their property and franchises to one newly formed company, should be to disapprove such sale, unless the total capitalization of the consolidated or new company, whether stock or bonds, issued in exchange for the securities of the old companies, is kept down so as not to exceed the total capitalization of the vendor companies."

In taking up the objection raised by the city that the price of electricity would be increased as a result of the deal, the commission points out that this is likely to prove a test case. "A business which supplies to a community a public utility like gas, or electricity for light and power," it says, "is one in which free and full competition between two companies engaged in the same business cannot be expected to prevail permanently. It can doubtless be demonstrated beyond any possibility of successful contradiction that better service and fair prices in the way of furnishing such public utilities to a community can, as a general rule, be given by one corporation than by several, and that this can be done with the use of less capital." Such duplication, it says further, involves public inconvenience in the erection of unnecessary and unsightly pole lines, tearing up of pavements, and so on, and while temporary benefit may result from competition, the usual result is eventual consolidation, poor service, and enhanced prices—the latter "in an effort to make the city and its inhabitants bear the burden involved in paying returns on the unnecessary capital invested in the duplicated plants.

"It is our belief that the provisions of the Public Service Commission law show a full appreciation of these facts by the Legislature of the State. While the law forbids consolidation, either directly or indirectly, without the approval of this commission, it at the same time permits such consolidation whenever in the opinion of this commission it is for the public advantage to do so, and recognizes that this may be the case by placing in the hands of the Public Service Commission great power, designed to secure the community in that case against poor service or extortionate rates." The commission accordingly prohibits the increase of prices over those that obtain at present.

The objection of the Attorney-General to the consolidation is dismissed with citations of the Appellate Division's decision in Rafferty vs. the Buffalo Gas Company and the recent decision of Justice McCall in the Consolidated Gas Company case in New York City, in which "the courts held that such consolidations do not create monopolies within the meaning of the statute."

Trolley Plant in New South Wales.

The street car lines of the State of New South Wales were opened in 1879, and in 1890 the first electric line was equipped, within five years from which time the whole system in Sydney and suburbs was converted to the overhead trolley system. The tramways of New South Wales are owned by the government and operated by a chief commissioner of railways and tramways, with an assistant commissioner appointed every seven years to manage both. Tramways are not subject to municipal control or rates. The single track electric mileage of the system is 137. A number of electric extensions are now in contemplation for city and country lines.

The power plant comprises seven units with a total capacity of 7900 kw. Each of the generators is driven by an Allis-Chalmers engine built in Milwaukee. Three of these engines are vertical cross compound units of 2500 hp each, and the other units are 1500 hp horizontal cross compound direct connected units.

There has recently been installed a Parsons turbine unit of 1750 kw rating, and there are two 5000-kw turbine units of the same type on order. These units are similar in design to those now built by Allis-Chalmers Company. There are forty-eight Babcock & Wilcox 350 hp boilers which furnish steam for the units mentioned. In addition to the main power house there are seven car houses, seven sub-stations and four battery houses belonging to the system. The rolling stock comprises some 700 motor cars, 50 trailers and 45 service cars.

Bright Plated Metal Surfaces.

As a rule, articles plated by the galvanic process—that is, in electrolytic baths—have a matt surface. Microscopic examination shows that this is because the surface is composed of minute crystals which disperse the light reflected therefrom even when they are not oxidized. In plating with copper this is especially noticeable. For many purposes this matt surface is desirable—as, for instance, where it is intended to subject the copper to the action of an acid or other solution, in order to give it a patina, or to produce the effect called "blood bronze," but where a bright surface is desired, it is necessary to resort to some mechanical means, such as burnishing or

polishing with the wheel, which, besides delaying delivery, increases the cost of production. The same is the case where iron or steel is plated with zinc; furthermore, the hot process is, for many classes of work, not applicable.

A recent German patent refers to a process by which it is intended to produce by electrolytic methods, in baths of ordinary temperature, a bright surface. This is attained by the addition to the bath of glykocides, phloroglukocides or other similar substances, or nitrogenous glykocides or their derivatives; or, instead of these substances, the extracts of plants or barks, as, for instance, althea, panama or licorice extract, which contain the substances above mentioned.

The employment of these materials enables the production in the bath, says the patentee, of a brilliant surface on the plated articles, without any mechanical aid. The metal is said to adhere well, so that, for example, zinc-plated iron sheets may be bent backwards and forwards at will without the zinc coming loose, which up to the present has not always been the case with sheets plated by the hot galvanic process.

Twenty-Five Years of Institute History.

Before the Schenectady chapter of the American Institute of Electrical Engineers, on Nov. 1, Mr. D. B. Rushmore presiding, a paper was read by Mr. T. C. Martin on 25 years of Institute history. It was pointed out in the paper that work for the formation of the society began in 1883, thus justifying the title. Mr. Martin remarked that he had filled every office in the Institute except that of treasurer, and added: "Speaking as the senior surviving president of the Institute, it might be expected that I should make some allusion to the 19 men who have held the office since the beginning in 1884. How some persons get elected to presidential office is a mystery, even granting their great individual qualifications; and it is equally strange how others miss the distinction. It does not follow that because a man is a great engineer or inventor he has the executive ability for leadership; and moreover he may be right in shunning instinctively that which would only be a distraction from his true work. Two of our most distinguished members, known throughout the world, have not accepted this office; yet it is surely a matter for congratulation that of the 19 men, not fewer than 15 have been engineers very distinctively, and the names of 17 are attached to inventions some of which are the greatest of the last 50 years. This is a large proportion, particularly when it is borne in mind that no fewer than 8 of the 19 have followed the profession of teacher, and three have been journalists, who speak not as those having authority but as mere scribes. Perhaps the most striking fact about the list and the testimony it bears to the catholicity of the American engineering spirit as well as the manner in which our national strength is reinforced, is that 7 of the 19, including the present incumbent, were not natives of this country. The career open to talent that was regarded by Napoleon as such a desideratum, is obviously to be found in this country as nowhere else in the world." He pointed out, however, that the method of selecting presidents had shown itself susceptible of improvement.

Reference was made to the importance of the secretarial position and the fact that Mr. Ralph W. Pope had held the office almost from the beginning. Mr. Martin said: "It was a providential dispensation which gave us Mr. Pope's services, for with instant sympathy he took up the work of development that has gone on without cessation to the present moment. Unhasting and unresting, of him it cannot be said that anybody ever saw him in a hurry, but the work has always got done. The possession of the lymphatic temperament is, as in him, sometimes associated with a remarkable ability to accomplish. A few years ago, it is said, the pastor of a leading church died, whereupon, having in mind his virtues and labors the vestrymen put up a tablet on the walls with this quotation: 'Now the people of God have rest.' I can well imagine that when some administrations have faded into the background, our good secretary has felt like emulating the example of that vestry, for he has never fallen into the error of mistaking restlessness for achievement. Disraeli once compared his Liberal opponents to little children pulling up their plants every morning to see how much they had grown in the night. From such practice, the conservatism of our secretary has always saved us, and we have had the growth just the same and all the more. His first report, presented in May, 1886, showed a net total of 250 members. We now have over 5000 not including students, so that our membership has multiplied 20 times in the period. The average budget was then less than $1,000. It is now $70,000. Granting the tremendous development in our field of engineering, it remains evident that only conscientious care and a thorough grasp of the situation could have brought us through all these years to the firm, stable and prosperous position we now hold. Comparisons were long since given a bad name, but it is only by noting the progress of other societies that we can realize how far and fast our own Institute has traveled. In the year when the A. I. E. E. was organized, 1884, the American Society of Civil Engineers had 838 members. At the beginning of this October, it had 4287, and by the end of this year will have 4400. In 1884, the American Institute of Mining Engineers had 1381 members; on Oct. 5 it had 4179. At the close of 1884, the American Society of Mechanical Engineers had 557 members and on Oct. 1 it had 3335 members. Hence, in spite of their flying start and time allowance, the A. I. E. E. has outrun all the other societies, and with its 5000 members is distinctly in the lead. I don't know that there is any special credit in this; it is simply a fact worth noting; it may carry an implication or prophecy as to relative numerical importance later on. The growth of these sister societies is reason for hearty congratulation all around. The enrollment in four national technical bodies of nearly 17,000 professional members is surely an indication of the growing influence of engineers and engineering in a civilization that they at least as much as any other factor have created."

Mr. Martin pointed out how much of the work of the Institute realized the hopes and ideals of its founders, and was still being carried on along lines laid out originally. He referred to the new Engineering Building, and the Institute fund of $160,000 already raised, and said: "The joint library in the new Engineering Building, given us by Mr. Carnegie, is one of the best evidences of the good that flows already from the creation of the new home. There we have what is probably, even now in the earlier stages of organization, the best collection of engineering literature in the world. It is constantly securing valuable accessions, and students more and more frequent it. Together with the grand Public Library on the next street, now being finished, it will constitute the best center of scientific and literary investigations, through the printed word, to be found on this continent. When our past president, Dr. Wheeler, with generous impulse, gave us the Latimer Clark Library, he little thought that from such a nucleus, or so soon, would come in reality, both the building and the splendid larger library it now enshrines. We Electricals are, indeed, not as appreciative as we ought to be of what has come through Dr. Wheeler's initiative and liberal gift—a critical event in Institute history determining all the future."

After referring to the successful creation of branches; the transactions now embracing 25 substantial volumes of some 16,000 pages; and the exchange of international courtesies, Mr. Martin comented on standardization and code work and said: "To make laws is a confession of human weakness; but the desire to legislate for fellow men springs ever in our breasts. The Institute has found abundant occupation in standardization of material and more latterly has branched off into the standardization of morals. In all, this only commendation can follow, but there always lurks the peril of petrifaction. 'Our little systems have their day. They have their day and cease to be. They are but broken lights of Thee, and Thou, O Lord, art more than they.' No standardization must be final; it is only a basis for new departure if it is worth anything. Of all others, the electrical arts are to-day most in a state of flux and transition, and the bondage of prescription cannot be laid upon

them. The greater the number of conditions we agree upon, the larger should be the freedom for all else."

"Codes of ethics are the latest efforts at standardization to occupy our thoughts in the Institute. It is a sign of the times, an admission on the part of the individual that before he flays alive a corporation he ought to examine his own credentials as executioner. We must of course all be in sympathy with the effort to secure affirmation for such a code as is proposed for the Institute, but no virtue of purity or salvation lies in the code itself. It is a mere formula of words and phrases. The moral law has never been observed by a single human being since it was given shape, yet the world has steadily grown better through the unconscious striving of our race upward and onward. Codes of ethics are besprinkled thickly through the ages; declarations of faith and fervor come into political platforms once a year; and the man who when asked to sign the Thirty-Nine Articles regretted there were not forty does not stand unique. By all means let us have a code but do not let us expect too much of it. Not long ago a northerner went into a southern village store and asked for a pair of socks, size No. 10. The storekeeper was sorry, but he kept only one size, No. 12. 'Why,' said the astonished northerner, 'surely you don't mean to say that every man and boy in this village wears the same size sock?' 'Oh, no!' was the cheerful, ready answer, 'but if the socks happen to be too long they pull 'em up at the heels, and if they are too short they tugs 'em down at the toes.' It is thus with all codes made like ancient torture beds, to fit all cases and all men."

The paper concluded with an appeal to the younger members to interest themselves in Institute work.

November Meeting of A. I. E. E.

At the meeting of the American Institute of Electrical Engineers, held on Nov. 8, the comparative performance of steam and electric locomotives was discussed, a paper on this subject being presented by Mr. A. H. Armstrong. An abstract of this paper is given on page 971 of this issue.

In a written communication, Mr. W. J. Wilgus, mentioned the striking advantages of the electric over the steam locomotive as found in the New York Central installation. In this installation coal consumption per car-ton mileage in high-speed service, as compared with slow-speed service, is 165 per cent, whereas under exactly the same conditions, the increased consumption of energy for electrical equipment is only 18 per cent, a difference in favor of electrical operation of 147 per cent. The net results of all of the economical advantages of electric operation, over steam, for the conditions existing on the New York Central, after including all elements of cost of additional plant, shows a saving in summer months of from 12 per cent to 27 per cent, depending on the character of the service. A larger saving may be expected under winter conditions.

In addition to the above saving, the nuisance and dangers from smoke and gas in the Park Avenue tunnel have been eliminated, and the passenger service of the Grand Central terminal has been increased by about one-third. Later, when the New Haven Company completes its change of system, exclusive electrical operation in the tunnel will permit the use of shorter blocks, and correspondingly increase the service of the four-track main line entrance to the terminal.

Because of less cost of maintenance of electrical equipment, and less idle time in shops, the greater cost of interest charges and depreciation is not only neutralized, but a net saving in repairs and fixed charges over steam equipment is effected of 19 per cent. Electric locomotive inspection and light repairs, as compared with coaling, watering, drawing fires, repairs, etc., of steam locomotives, shows a saving in time in favor of the former of over four hours per day, equal to 18 per cent. The electric locomotive, while busy, is a much more nimble and efficient machine than the steam locomotive, showing an increase in daily ton-mileage of 25 per cent.

While not so important in freight service, the question of locomotive weight is a large factor in a comparison of the relative economy of handling passenger traffic by steam and electricity. For instance, in switching service at the Grand Central terminal, 65 per cent of the total steam ton-mileage is due to locomotive or "dead" weight, while the electric locomotive percentage is only 54 per cent, a saving for the latter of 11 per cent. In the regular schedule service, the steam locomotive shows 51 per cent dead ton-mileage, as against 35 per cent for the electric equipment, a saving for the latter of 16 per cent. When it is realized that this saving of "dead" ton-mileage has a direct proportionate effect on the cost of fuel and electric energy, and an indirect effect on wages and fixed charges, its importance is manifest.

Dr. Cary T. Hutchinson said that the constant-speed characteristic of three-phase motors was looked upon as a distinct advantage by the engineers of the Great Northern road. It is advantageous to be able to limit the speed of trains going down grade, not so much on account of the energy recuperated as of the simplicity in handling the train and the reduction in the required generating station equipment.

Mr. N. W. Storer called attention to the fact either three-phase, single-phase or direct-current locomotives offer sufficient advantages over steam locomotives to justify the substitution in many localities. He stated his belief that the substitution will take place just as rapidly as the manufacturing companies of the country are able to handle it.

Mr. W. S. Murray stated that the saving in cost of coal when electric are substituted for steam locomotives should not be ignored, because it represents one of the most important advantages of the former. The following table shows the saving of fuel which will be effected on the New York division of the New York, New Haven & Hartford Railroad when all freight and passenger trains, now operated by steam locomotives are hauled electrically:

	Ton-Miles per annum	Tons of Coal		Cost of Coal		Saving, Electric over Steam
		Steam	Electric	Steam	Electric	
Express.....	592,240,000	57,447	29,870	$183,830	$89,620	$94,210
Express (local)..	348,000,000	58,300	28,600	186,560	85,800	100,760
Freight.....	2,223,000,000	187,844	139,010	563,530	417,030	146,500
Total	3,163,240,000					$341,470

The above values have been based on tests of ten locomotives throughout eighteen consecutive days of operation. Express locomotives required 28 lbs. of water per indicated hp-hour, and freight locomotives 30 lbs. The cost of repairs and maintenance average 8.1 cents per locomotive-mile in freight service and 5.6 cents in passenger service. An electric locomotive requires about 2 cents per locomotive-mile for repairs.

Mr. Wm. McClellan remarked that it is extremely difficult to obtain reliable data as to the economies that may be obtained by eliminating the steam locomotive. Not until a complete steam locomotive stage has been electrically equipped, so that the electric locomotive can entirely displace the steam locomotives, and the electric locomotives have been operated for a considerable time, can an accurate estimate be made of the economies of substitution.

Prof. C. L. De Muralt gave data showing that a certain double-track road eighty miles in length, which had reached its limit in haulage under steam locomotive conditions, could be equipped with two additional tracks for about $15,000,000, while it could be provided with complete electrical equipment for the former two tracks for about $3,000,000. With the electrical equipment the saving in operating expenses would be about $200,000 out of $8,000,000 per year, while a 40 per cent increase in traffic could be obtained over the same tracks.

Dr. C. P. Steinmetz stated that the leading conclusion of Mr. Armstrong's paper, that the advantage resulting from elec-

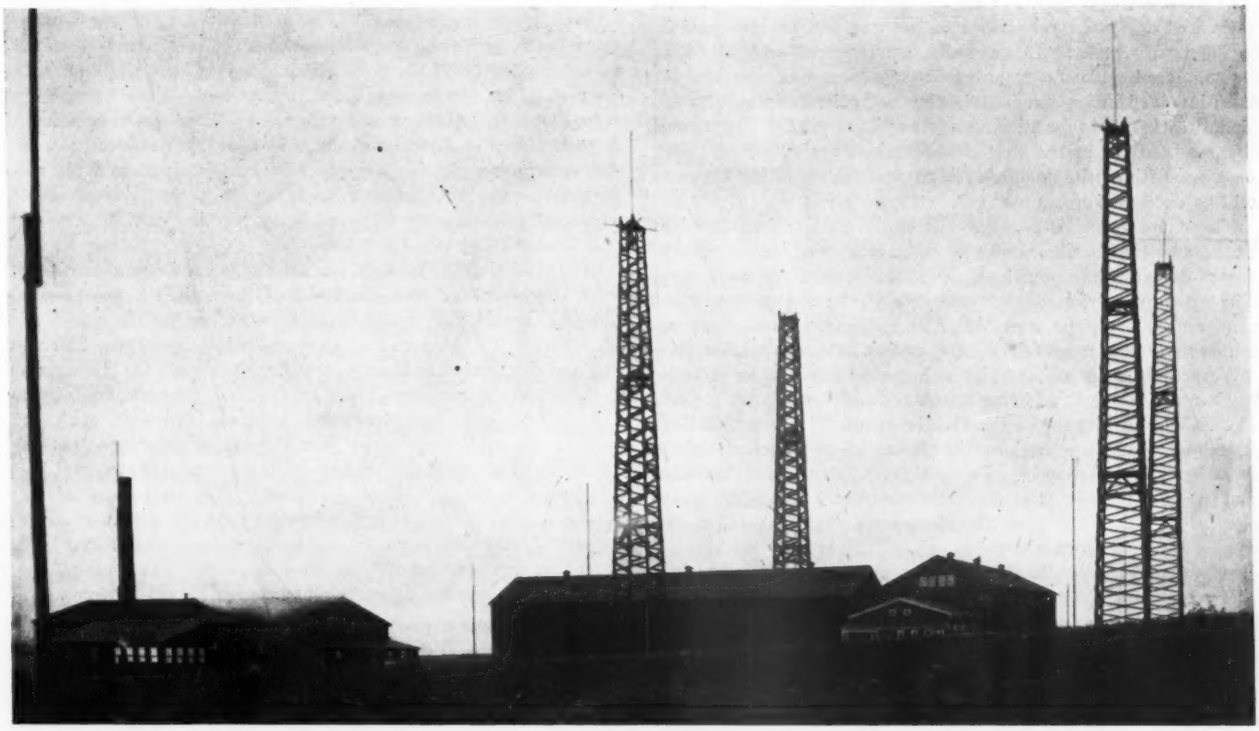
trically equipping steam roads is to be found in the ability of the road with the same trackage to handle a greater amount of traffic. This, however, means that the change from steam power to electric power is not a mere substitution of the electric locomotive for the steam locomotive, but a readjustment of the ways of operation, that is, an increase of the speed of operation of freight service by taking advantage of the feature of the electric locomotive being able to maintain a high drawbar pull at a higher speed. When one kind of motive power is substituted for another, it always means, not a mere substitution, but a rearrangement. Nearly a century ago the stage coach was replaced by the steam engine. The first attempts to attach the steam engine to the stage coach and pull it over the country roads naturally came to naught, and it was successful only when the carriage was put on an iron track, and thus the present steam locomotive traction was developed. One characteristic of the steam locomotive is that it is essentially a constant power motor. The steam locomotive can give approximately the same power whether running at high or low speed. The limit is the steaming ability of the boiler. When the ability of the boiler to produce steam is exceeded drawbar pull is lessened. In the electric motor, however, the limitation essentially consists in a constant loss of power. The limit of the electric locomotive is that it can lose only so much power in the motor, to be within sufficient heating limits. Since efficiency rapidly increases with the speed, more power can be obtained at higher speeds up to a certain limit, and, therefore, the electric locomotive is better at the higher speeds than is the steam locomotive, and advantage must be taken of this feature if the best results are to be obtained. There must, therefore, be a readjustment, especially of the most important part of the railway; the freight traffic must be readjusted to higher speed. Higher speeds necessarily mean increased service from the system, even without any increased drawbar pull, and even with lesser drawbar pull. In this feature lies the main advantages of electric traction, but it becomes necessary to readjust the method of operation to the changed condition of railroad motive power in order to get the best results of the electric locomotive.

The Wireless Station at Glace Bay.

Various details have been given in these pages recently as to the resumption of regular commercial business across the Atlantic by the Marconi system, and we are now able to present a view of the interesting plant at Glace Bay, Nova Scotia, which communicates with Clifden, in Ireland. The building to the left with the high stack, is the engine house. The two large buildings near the towers are the condenser rooms, and the house with the white trimmings contains the operating rooms proper.

The towers are 215 feet high and the small poles on the top of them are about 50 ft. in height, giving a total height of about 265 ft. The aerial wires are about 50 in number and are run from the top of the poles before mentioned, practically horizontally for several hundred feet in a westerly direction, dropping at the easterly end from the towers to the operating room, advantage thus being taken of Mr. Marconi's directive system.

At the time of the erection of the station, it was expected that a large radial aerial would be employed and for this reason the towers were surrounded by circles of 8 and 16 masts, each 175 ft. high, but this arrangement has been discarded for the present directive one, so that actually four towers and four masts only are now employed. Indeed, the necessity for heavily constructed wooden towers no longer exists. At the Clifden station in Ireland, they are done away with, and six poles only are used for the support of the aerials.



MARCONI WIRELESS TELEGRAPH PLANT AT GLACE BAY.

Employed at the Glace Bay station are the manager, Mr. R. N. Vyvyan, four assistant electricians, four telegraph operators, two engineers, two firemen, two carpenters, two machinists and two riggers, so that altogether, with the families of all these people, there is quite a little colony on the cliffs.

As the source of prime power, the plant has a 500-hp Browett condensing steam engine, driving by direct couple a 350-kw, 3-phase alternator, generating at 2000 volts, although so far only 70 kilowatts is utilized for the transmission of messages.

Signals, when this amount of power is used, are very strong, quite sufficiently so to preclude any possible interruption of the service by atmospheric disturbances of the strength usually obtaining at this time of the year.

We are indebted to Mr. W. W. Bradfield, chief electrical engineer of the Marconi Wireless Telegraph Company, for the photograph and data. Mr. Marconi, who has just sailed from Canada for England, is to lecture soon on his work before the Royal Institution, in London; and he has promised also to appear before the American Institute of Electrical Engineers on his return to America during the winter.

Three-Phase Locomotives for Swiss Railroad.

Work has just been started on one of the most important electric railway projects undertaken either in this country or abroad. Among the trunk lines crossing the Tyrolean Alps the Arlberg line is probably the busiest. It is a link in the line from Vienna, through Switzerland to Paris, and being the only direct line east and west between these two points, it carries the greater portion of the traffic. For some years past traffic congestions have been unavoidable during certain seasons, and it was principally to ameliorate these conditions that electric traction was decided upon. Electric locomotives more powerful than any steam locomotives available will handle trains of considerably greater weight, and they will be run at speeds of from 25 to 30 per cent higher than the present locomotives. It is estimated that the total service of the line will be increased by at least 50 per cent, with a comparatively small capital outlay as compared with the tremendous expense which would have been involved in any grade reduction or in the building of additional tracks, the only other means for increasing the service of the road. It is stated that the electrical equipment will cost only one-fifth of the double-tracking, and the operating expenses will be decreased by 25 per cent.

The Arlberg line is a typical mountain division between Insbruck and Feldkirch, about 140 miles long, single-track except for a double-track tunnel at the summit about 7 miles long. The maximum grade on the east side of the tunnel is 3.14 per cent, and that on the west side 2.64 per cent. The curves are numerous, but are of fairly large radius. At the present time there are about 40 daily trains going over the line in each direction, about one-third being passenger and the balance freight. Prof. C. L. de Muralt, of the University of Michigan, has been appointed consulting engineer in charge of this project by the Austrian State Railways. Prof. Muralt has decided to equip the line with three-phase alternating-current locomotives, principally because it has been found that the three-phase locomotive is more powerful for any given weight than either the direct-current or single-phase. This point is of considerable importance in determining the solution of a problem involving the particular considerations that obtain on the Arlberg line. As a matter of fact, the drawbar-pull and speed which are specified demand an output of practically 3000 horse-power for a locomotive weighing not more than 60 tons, a requirement which has not thus far been met by any but three-phase locomotives. In addition to this it is estimated that some $200,000 will be saved annually by the return of energy to the system by trains descending the grade, in addition to the saving in maintenance of brake rigging and wheels made possible by electric braking. While it is true that any electric system can be made to return energy to the system while coasting down a grade, certain modifications from the standard equipment must be made in the case of the direct-current and single-phase locomotives, while the three-phase equipment will regenerate automatically and without any complications whatever.

There will be about 50 locomotives, of which five or six will be for reserve. A regular system of inspection and repairs will be instituted with the intention of keeping the equipment at all times at the highest possible efficiency. The hydro-electric station will have a maximum output of about 40,000 kilowatts. It is probable that two separate stations will be built, one on either side of the tunnel. Two years is the estimated time for the completion of the entire plant, and at the expiration of that time the entire steam equipment of the road will be supplanted by the three-phase locomotives.

CURRENT NEWS AND NOTES.

A. I. E. E. AT PITTSFIELD.—The opening meeting of the Pittsfield, Mass., section of the American Institute of Electrical Engineers was held there on Nov. 2, at the Wendell House. Mr. Joseph Insull, chairman of the section, presided and spoke, and an interesting address on Institute work and policy was delivered by Mr. D. B. Rushmore, chairman of the Schenectady section. A report was also made by Mr. H. W. Tobey as to institute branches in general. Mr. H. L. Smith, the secretary, announced a number of topics and papers for the current season, including as authors, Messrs. H. H. Barnes, Jr., W. Stanley, Ernst J. Berg, C. E. Eveleth, E. B. Merriam, W. S. Moody and S. H. Blake, all specialists in various fields. The meeting was followed by a reception.

ELECTROMETALLURGY IN FRANCE.—The Société Electrometallurgique, which has applied the electrometallurgical processes of Paul Girod, has now in operation plants in France and Switzerland consuming 14,000 kilowatts of electrical power, all of which is produced by water power. A fourth plant of 5000 horse-power will be completed this year, and when other water powers in the Alps owned by this company are developed, the total electrical power available will be raised to over 40,000 horse-power. The productions of this company consist of ferro-chrome, ferro-tungsten, ferro-molybdenum, ferro-vanadium and pure vanadium, ferro-silicon, titanium and ferro-titanium, ferro-manganese, cupro and nickel vanadium, silico-chrome, silico-manganese, ferro-boron, ferro-tantalum, ferro-uranium, cupro-silicon, etc. The largest products are, in the order named, ferro-silicon, ferro-chromium and ferro-tungsten; 6000 tons of the former were produced last year. The total sales amount to about $2,000,000 per year.

LIGHTING RATE REGULATION.—Last week in New York City, speaking from the bench of the United States Circuit Court, Judge Hough, who is hearing argument on the report of Mr. Masten, the Master, on the constitutionality of the 80-cent gas law, declared that it was exceedingly difficult for the courts to determine where regulation ceased and confiscation began. The attitude of legislative and judicial bodies is such at present, he said, that there is no form of industry that is not likely to be made the subject of intervention by the Legislature and the courts. He also intimated that his present views on the case coincided closely with those of the gas company's lawyers. James M. Beck, of counsel for the Consolidated Gas Company, was arguing that the 80-cent gas bill was confiscatory and therefore unconstitutional, when Judge Hough interrupted: "I find it very difficult at the present time," he said, "to define the difference between regulation and confiscation. I have asked for the opinion of other counsel, and I now ask yours." "Regulation is the orderly ascertainment of what is a reasonable rate, with its enforcement," replied Mr. Beck, readily. "Confiscation is the seizing of all property or earning power without any allowance as to compensation." He went on to say that the matter of regulation was one of fact, connected with the laws of business which were infinitely greater than constitutions and governments, "for, as we speak of governments they are a sort of glorified police force at best." "It appears to me," said the judge, "that if this 80-cent rate should be declared unjust another bill, for 85-cent gas, might be introduced and an entirely different set of facts and conditions would have to be determined upon. And if gas can be made the subject of such regulation then bread can likewise be affected. There is, in fact, no form of industry that cannot be, that is not likely to be, as a matter of fact, the subject of just such intervention by the Legislatures and the courts within a very short time. Then there is a tendency to do away with the judicial review. The Keppler bill is an attempt in that direction. The courts, of course, must be guided by the constitutionality of various acts and by decisions which have previously been made bearing upon it. I am inclined at present to assent to your view with regard to the subject."

TELESTEREOGRAPHY.—Edouard Belin, a Frenchman, has, according to a Paris despatch, invented a method of transmitting pictures by telegraph, which is distinguished from Prof. Korn's system by being wholly mechanical. Several of the Paris papers recently reproduced photographs transmitted by the new system which has been called telestereography.

TELEGRAPH STRIKE ENDED.—Having long since proved a fizzle, the telegraph strike has now been regularly "called off" by the various branches of the union, and is a thing of the sad past. The telegraphers have flocked back to get their jobs, on terms of unconditional surrender, but in most instances have found no employment, the companies being well supplied with operators. There seems to have been a good deal of suffering toward the end among those who went out so suddenly at the call of a whistle in a strike that had not been authorized.

TELEPHONY IN CHICAGO.—The Chicago Telephone Company's existing franchise expires in 1909, and the aldermen of that city have just granted to the company an extension for 20 years, so that the company can plan for extensions and improvements. A business telephone will cost $120 a year, a residence instrument $72, and a private exchange $368 per annum. A subscriber to a two-party line can get his service for $48 a year. Five cents is the rate for a message sent from a pay station, and the company is required to pay to the city, semi-annually, 3 per cent of the gross receipts of all its business inside and outside of the city. In 1929 there will be another readjustment. Chicago should soon enjoy to the full the measured-rate system which has been such a boon in New York, and has enabled the New York Telephone Company to give a service of unequaled efficiency. The Chicago Telephone Company gained 3016 subscribers in October and since January has added 28,098.

COLOR VALUES OF ARTIFICIAL LIGHTS.—Mr. H. V. Allen, of the General Electric Company, addressed the electrical section of the Western Society of Engineers, at Chicago, Nov. 8, on "The Color Values of Artificial Lights." Mr. Allen, who is associated with Mr. W. D'A. Ryan, showed a number of experiments presented by Mr. Ryan and associates at similar lectures elsewhere. The effect of fog and cloud in modifying white light was shown by projecting a light upon the screen which passed through a fog medium, the fog being produced artificially in the experiment. To show the effect of different artificial lights on common colors or goods, four booths were arranged, containing respectively an inverted gas mantle burner, a Nernst lamp, an enclosed arc lamp and incandescent lamps. These experiments served to demonstrate admirably the different color values given by common, every-day illuminants.

JOHNSON'S MUNICIPAL MACHINE.—With regard to the reelection of Mayor Tom Johnson, at Cleveland, his opponent, Congressman Burton, says: "No one can appreciate the strength of Mayor Johnson's machine. The work of thousands of men, their positions at stake, trained to political service and many of them with friends and relatives equally interested, is a factor strong enough to determine any election under ordinary circumstances. This machine manifested its power. No volunteer organization could equal it in efficiency. It was like a contest between regular troops and raw recruits. Another factor was the almost united support given Mayor Johnson by the liquor interests of the city. One great advantage which lay with Mayor Johnson in this campaign as compared with others was the operation of lines carrying passengers at a 3-cent fare, and the impression that a system would be established on which a 3-cent fare would be charged, and which would include the whole city."

TELEPHONE ELECTION RETURNS were more a feature than ever of the elections in New York City on Nov. 5. By permission of Commissioner Bingham telephones were installed in police stations at 25 strategic points, and here were stationed men who have been regularly employed for some years past in the transmission of returns. In the main office 10 receiving telephones were placed. Each was attended by an operator from the telephone company. There were also 7 sending telephones, over which the news was distributed to groups of three newspapers. When the telegraph system was in use one man would place the 21 newspapers upon a single loop and flash the returns to all at once. With the telephone this was deemed impracticable, three newspapers upon one line being regarded as a better plan. The receiving operators would take upon small bulletin sheets the count from the men in the various police stations as it was handed in, for instance: "Ten districts out of a total of 55 in the Thirty-first Election District give Foley 5000, Ihmsen 4000," and so on. The next returns received from this district would be added to the total already known, the number of districts still to be heard from reduced, and the results sent out by the sending operators. In this way the returns were handled without a hitch at the rate of 56 bulletins an hour, a record that compares favorably with the telegraph system.

RAILROAD REBATES.—Before one member of the Interstate Commerce Commission, Mr. Harlan, an argument was presented in New York last week on behalf of the General Electric Company in connection with its claim that it should receive an allowance of about $100,000 annually from the New York Central & Hudson River Railroad and the Delaware & Hudson Railroad for the work of shifting cars from the railway tracks to various parts of the electric plant. Previous to an indictment of the two roads for rebating, they had made payments to the General Electric at the rate of about $50,000. The case against the New York Central, tried before Judge Ray in Syracuse, resulted in a disagreement as to whether the sums paid constituted a rebate or a proper allowance. The General Electric Company has an elaborate switching system of its own, started more than 10 years ago with one small engine. The Delaware & Hudson has no yard in Schenectady, while that of the Central is inadequate. At times, according to Mr. Adelbert Moot, the electric company's lawyer, the Central has as many as 700 cars in the yards of the company. Demurrage on them to the extent of more than $30,000, it has already paid. The General Electric was forced to install its own switching system on account of the delays of the railroads. It now demands the allowance mentioned for the work so done.

DINNER TO CARROLL D. WRIGHT.—At the Engineers' Club, on Nov. 9, a dinner was given to Dr. Carroll D. Wright, former U. S. Commissioner of Labor, when the cross of the Legion of Honor was bestowed on him by the French Government in recognition of his services in the betterment of industrial conditions. The host of the evening was Mr. Charles Kirchoff, chairman of the advisory council of the Museum of Safety Devices and Industrial Hygiene, to whose work Dr. Wright has given hearty support. The decoration was conferred by Mr. Bonzom, acting consul general, and letters of congratulation were read from President Roosevelt, Hon. S. N. D. North, director of the U. S. Census, and Hon. Andrew D. White, former minister to Germany. Dr. Josiah Strong presided, and speeches were made by Dr. W. H. Tolman, of the Institute of Social Service; Dr. F. R. Hutton, president, American Society of Mechanical Engineers; T. C. Martin, president of the Engineers' Club, and Dr. Wright. Among those present were Charles R. Flint, Rev. Dr. Percy S. Grant, David Williams, C. Whiting Baker, Prof. F. R. Hooper, F. A. Halsey, Dr. E. F. Roeber, Albert Spies, George Gilmour, Wallace P. Groom, C. C. Cluff, of the Carnegie Steel Company; W. E. Howland, of the *Outlook;* Dr. L. L. Seaman, etc. After the dinner a visit was made to the new museum on West Thirty-Ninth Street, to see the preparations for its early opening to the public. It was announced during the evening that Dr. Hutton had consented to take the chairmanship of the jury of award for the *Scientific American* gold medal just founded in the Institute.

AMERICANS HONORED.—The Royal Society, with the approval of King Edward, has awarded the Copley Medal to Prof. Albert A. Michaelson, of the University of Chicago, for optical investigation. It has awarded the Davy Medal to Prof. Edward Williams Morley, of Cleveland, Ohio, for his investigations in physics and chemistry, and especially for his determination of the relative atomic weights of hydrogen and oxygen.

HUGE COPPER PURCHASES.—Advices from London state that a pool, in which the largest copper consumers of Europe are represented, was recently formed in that city, and has purchased 50,000 tons of copper. The price paid is slightly above the prevailing price in the market. The copper is to be delivered in November and December. The amount involved is approximately $15,000,000, which is to be paid in London on delivery.

WAR BALLOONS.—A special cable dispatch from Berlin announces that the Siemens-Halske-Schuckert Electric Company has decided to make a business of building military airships and selling them, just as the Krupps supply cannon to various countries of the world. The company has begun the construction of an airship designed to outstrip in speed and power all the dirigibles so far built. It has also been experimenting with flying machines.

MELTING POINT OF TUNGSTEN.—In some recent careful determinations made by Wartenberg, the melting point of pure metallic tungsten was found to be at least 2800 deg. C. and probably not over 2850 deg. C. The determination was made by heating the metal electrically in a vacuous bulb and employing a carefully calibrated optical pyrometer. For comparison the same experimenter measured the temperature of the positive crater of the arc lamp, which varies somewhat with the kind of carbon used, and determined this to be 3350 deg., while Reich had found 3430 deg. with the same kind of pyrometer.

THE BIDWELL SWINDLE.—For some time past the Bidwell Electric Company of Chicago has been advertising the sale of stock in its "cold motor," making most absurd statements and claims. Any number of inquiries about it have been addressed to this office. A federal warrant charging the use of the mails for fraudulent purposes has now been issued, and on Nov. 1, Charles F. Bidwell, the secretary, was taken into custody after a fight and, failing bail in $3,000, went to jail. A warrant is also out for Benson H. Bidwell, president of the company. It is said that 4300 investors have bought at least $200,000 of the stock.

MUSEUM OF SAFETY APPLIANCES.—Word has just been received that the international jury in the section of social economy at the International Book, Paper and Publicity Exposition, which closed in Paris last month, made an award of the grand prix to the American Museum of Safety Devices and Industrial Hygiene. A diploma of honor, the second highest award, was made to Messrs. Charles Kirchhoff and T. C. Martin, respectively chairman and vice-chairman of the museum's advisory council, also to Dr. L. L. Seaman and Rudolph Lenz for their active interest in promoting this work. The museum is now occupying the entire fifth floor at 231 to 241 West Thirty-Ninth Street, New York City, and all inquiries for space, exhibits and other information should be sent to Dr. W. H. Tolman, director of the museum.

LIGHTING AT MINNEAPOLIS.—We are informed by Mr. L. A. Lydiard, city clerk of Minneapolis, Minn., that a few months ago the City Council passed an ordinance providing that the city should establish an electric lighting plant, with an output sufficient to take care of all the lamps on the streets, about 1100 in number. The ordinance provides that the city engineer shall submit to the Council an estimate of the cost of constructing the plant. This estimate, we learn, has not yet been submitted. As there are no funds available for the work, it is hardly likely that under the most favorable circumstances any construction work can be begun this year, as it would be necessary for the board of tax levy to make provision for the expenditure. Moreover, money market conditions are now highly unfavorable to such municipal enterprises.

WHAT NEW YORK SPENDS.—Last Sunday Comptroller Metz, of New York City, addressed the "New Yorkers," a woman's club founded last year for social purposes. His speech was entitled on the program, "Financial Greeting." He said: "The city budget is enormous. Each month $1,000,000 is paid out in cash for salaries, and the salaries altogether, for the whole year, come to $71,000,000. The city spends annually $400,000,000—that is, more than London, Paris, and Berlin all put together. This means that we are doing in one year what they did in centuries. The city is growing tremendously, and we are rebuilding it from end to end. At present $50,000,000 is pledged to the city for parks and bridges, which we must have." He might have added that the city cannot show one well-paved street, and that its municipal supply of drinking water is vile. The only public services at all well run are those under private or corporate management.

NEW YORK POLICE TELEGRAPHS.—Police Commissioner Bingham has made some radical changes in the police telegraph system, suspending Superintendent Brennan, who has held the position for thirty years. He has had some fifty men under him. Early in the summer Commissioner Bingham engaged Prof. George F. Sever, of Columbia University, to investigate the police telephone system. Prof. Sever has just made a preliminary report, saying the present system is totally inadequate to handle police business. Mr. Henry F. Blackwell, who has succeeded Supt. Brennan for the time being, assisted Prof. Sever in his work. Commissioner Bingham had the Commissioners of Accounts investigate the bureau's method of issuing electrical supplies. Their report showed, he said yesterday, that no records had been kept of the supplies issued. Moreover, it is charged that the bureau has kept no maps whatever of the police cables, and that the department owns miles and miles of unused and unlocated cables. Detectives who have shadowed patrolmen detailed as linemen, have reported that they never went near any electric lines except the trolley lines leading to places of entertainment.

AMERICAN RAILROADS.—A pamphlet issued recently by Slason Thompson gives some interesting comparisons as to railroad values. The document is a spirited denial of the many charges which have been made by the critics of railroaods as at present managed. Where the net capitalization in 1906 has been officially declared to be only $11,671,940,649, the cost of the railroads, reached through several processes, is approximately $13,000,000,000. In comparing these figures with the cost of railroads in other countries Mr. Thompson shows that the some roads would cost: On Canadian basis, $13,384,240,000; on German basis, $21,969,000,000; on French basis, $28,712,000,000; on Belgium basis, $34,795,000,000, and on English basis, $58,644,000,000. On the ratio of assessed value to the true value of all property in the United States, as reported by the federal bureau, the assessment of American railways for the purpose of taxation is a certificate of value for $12,890,000,000, or more than $1,000,000,000 above their net capitalization. Although looking at the question strictly from the point of view of the railway officials, Mr. Thompson is a strong advocate of the popular demand for a governmental valuation of the railways. He denies, however, that the question of capitalization has any bearing on the question of rates. The prevalence of popular hallucinations as to values and rates, he says, emphasizes the necessity for an intelligent attempt by the government to ascertain and publish to the world a "reasonable, trustworthy estimate of the cost and true valuation of the railways of the United States."

Electrical Pumping Installation of the Lindal Moor Mines, England.

THE electrical pumping installation which has just been completed for the Lindal Moor Mines, of Messrs. Harrison, Ainslie & Co., is particularly interesting to engineers and the mining world in general, not only on account of the special features involved, but also because it is stated to be the largest and most comprehensive plant of its kind yet put down in Great Britain. The causes which led up to the adoption of the present scheme may be briefly summarized as follows:

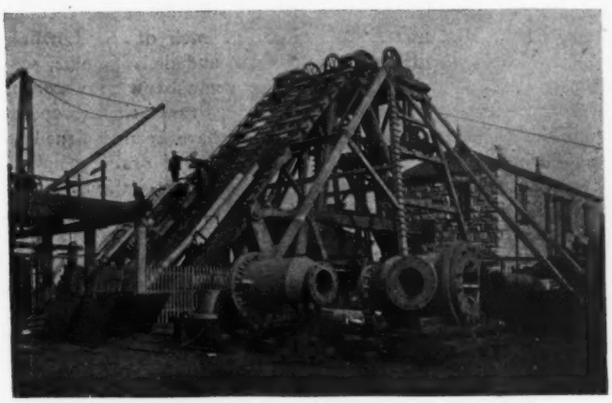


FIG. 1.—VIEW SHOWING INCLINATION OF PUMPS AT LOWFIELD PIT.

The Lindal Moor Mines, which are located near Ulverston, Lancashire, England, contain rich iron ore, and in several of the pits pumping operations ceased in December, 1903, owing to breakdowns and also because the then-existing pumping plant was not capable of coping with the inrush of water. The four pits affected are connected together either artificially or by natural drainage. At the time the pumping operations ceased, the maximum inrush of water reached nearly 7000 gals. per minute, though the normal flow in dry weather only amounted to about 4000 gals. per minute. About 3300 gals. per minute were pumped out by the old plant from two of the pits between which an artificial connection existed. As much water was pumped out of the two other pits. For the above-mentioned reasons and owing to the then-existing business conditions, pumping operations were abandoned in the four pits until the matter came up again for serious reconsideration in the beginning of 1906.

All the mines at which the new pumps are fitted contain large quantities of ore, much of which was in sight when the work was stopped by the overpowering inrush of water. It is confidently expected that an immediate result of the installation will be a gradual but great increase of the output of the mines, which at the present time is 250 tons per working day. A great feature of the installation is the mobility of the pumps and motors. With the electrical energy generated at one central station and transmitted to the pits, it is obvious that very little work will be involved in removing one or more of the pumps to other areas when the mines now being dealt with are pumped dry. It is already intended to adopt this course at an early date, when one or more of the pumps will be transferred to the large new shaft now in process of sinking on the Buccleuch area, to control the water on that portion of the company's estate. This, the Grievson shaft, in addition to being a pumping station and relieving the company of the present expensive system whereby eight pumps are employed, will give a greater working depth to the Lindal Cote mines. As the work of exploration is continuously carried on simultaneously with the working of the existing mines, it will be seen that there is every prospect of the new installation being fully used. The prospecting work is of very great importance, and with this work kept abreast of mining operations it is evident that with electrical energy readily applicable at any portion of the property, the development of the latter must inevitably be greatly facilitated and the output increased enormously.

In the four pits in question, three shafts were available for pumping plants; but the great initial difficulty to be overcome was the designing of a plant which could be efficiently handled in the very small pump ways, and it was only after five or six schemes had been proposed and rejected that a satisfactory solution was evolved. It was, further, a very difficult matter to design a plant of the required dimensions which would be capable of making any impression upon the inrush of water, and it was only the possibility of using electricity and high-velocity pumps which induced the owners to seriously reconsider the project for pumping the mines dry.

PUMPING PLANT.

In the Lowfield pit, Fig. 1, which is inclined at an angle of 43 degrees to the vertical, two centrifugal pumping sets have been provided, each of which is capable of delivering 4000 gals. of water per minute against a total head, including friction, of 395 ft. On reaching a depth of 378 ft., where the two shafts join, the two pumps will be connected in series, and the design is such that when working in series the pumps can together deliver the full 4000 gals. of water per minute against a total head of 780 ft. These two pumps are of the one-stage type and rest upon a special carriage running on rails, as shown in Fig. 2.

Each pump has two wrought-iron delivery pipes, which are connected at the top by means of a Y-pipe, which supports a rising main 14 ins. in diameter. The check valve has an internal diameter of 375 mm. (14.76 ins) and a foot valve with an internal diameter of 450 mm. (17.71 ins.) is fitted with a strainer. Each pump has a rope sheave 4 ft. in diameter mounted on brackets. Each of the motors direct-coupled to

FIG. 2.—ONE OF THE PUMPS AT LOWFIELD PIT.

the pumps is capable of a continuous output of 750 brake horsepower when working on a circuit having a potential of 3000 volts and a frequency of 50 cycles. The speed of the combined set is 1485 r. p. m.

In the Diamond shafts, two vertical sinking pumps are provided, each of which is capable of raising 1000 gals. of water per minute against a total head, including suction, delivery and pipe resistance, of 680 ft. These pumps are also fitted with

direct-coupled motors having a rating of 315 horse-power at a speed of 1480 r. p. m. The pumps in this shaft are of the three-stage type, and are fitted with elastic couplings and cast-iron intermediate piece for connecting and centering the pumps with the motors. A breeches pipe is provided in each case with

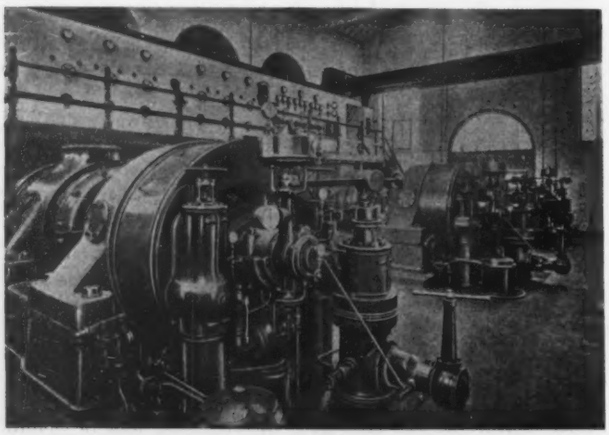


FIG. 3.—VIEW OF POWER PLANT SHOWING TURBO-GENERATORS.

wrought-iron suction pipe, foot valve and strainer. There are also wrought-iron delivery pipes connected at the top by a Y-pipe, which supports the rising main. Each pumping set is entirely enclosed in a framing of structural iron and a suitable rope sheave is provided for carrying the weight of the entire pump with its motor, cable and delivery pipe when filled with water under normal working conditions. On the side of each set is a service ladder with a wooden platform at the top and bottom.

In the two Berkune pits, two pumping plants of similar construction to those in the Diamond shafts are provided, but in this case each pump is designed for delivering 1000 gals. of water per minute against a total head of 540 ft.; the motor being rated at 250 horse-power and the speed of each set being 250 r. p. m. These pumps are of the five-stage type, and the arrangement of valves and pipes is the same as for the pumps in the Diamond shafts. The steel cables by which the pumps are lowered into the pits are fastened at the pit heads, from which point they go down their respective shafts, round the rope sheave of each pump, and up again to the top of the shafts, where they are wound round the winches provided for the purpose of raising and lowering. The delivery pipes for the vertical pumps are each stayed in position by means of the steel-wire ropes which pass up and down either side, stay rods being provided at various points with suitable guides through which the cables pass. The weight of each of the Lowfield pumps complete with its motor, suction and delivery pipe, suspension cable, electric cable and its own column of water, is about 75 tons. With a view to affording rapid sinking operations the Diamond and Berkune pumps have been designed so that during the first half of the operations of draining only a few of their impellers will be in use. When the halfway stages are reached the full number of impellers will be brought into action.

From the above it will be evident that the total initial quantity of water with which the whole plant will be able to deal is about 15,000 gals. per minute, this being reduced to 8000 gals. per minute as the pumps reach the lower levels. The centrifugal pumps were built by Sulzer Bros.

The motors are of special design for working under abnormal conditions, and are constructed with particularly narrow dimensions to admit of their passing down the existing pumpways. They are fitted with short-circuited rotors, and the motor cases are arranged with ample ventilation, a forced circulation of air being maintained by means of fans fitted on the motor shafts. Although the motors are of the ventilated enclosed type, there is ample protection provided by means of suitable hoods against falling water, fragments, etc. A feature of the installation is that the motors are connected directly to the 3000-volt lines without intervening transformers, all terminals and live parts being protected so that there is no risk of danger to the operators.

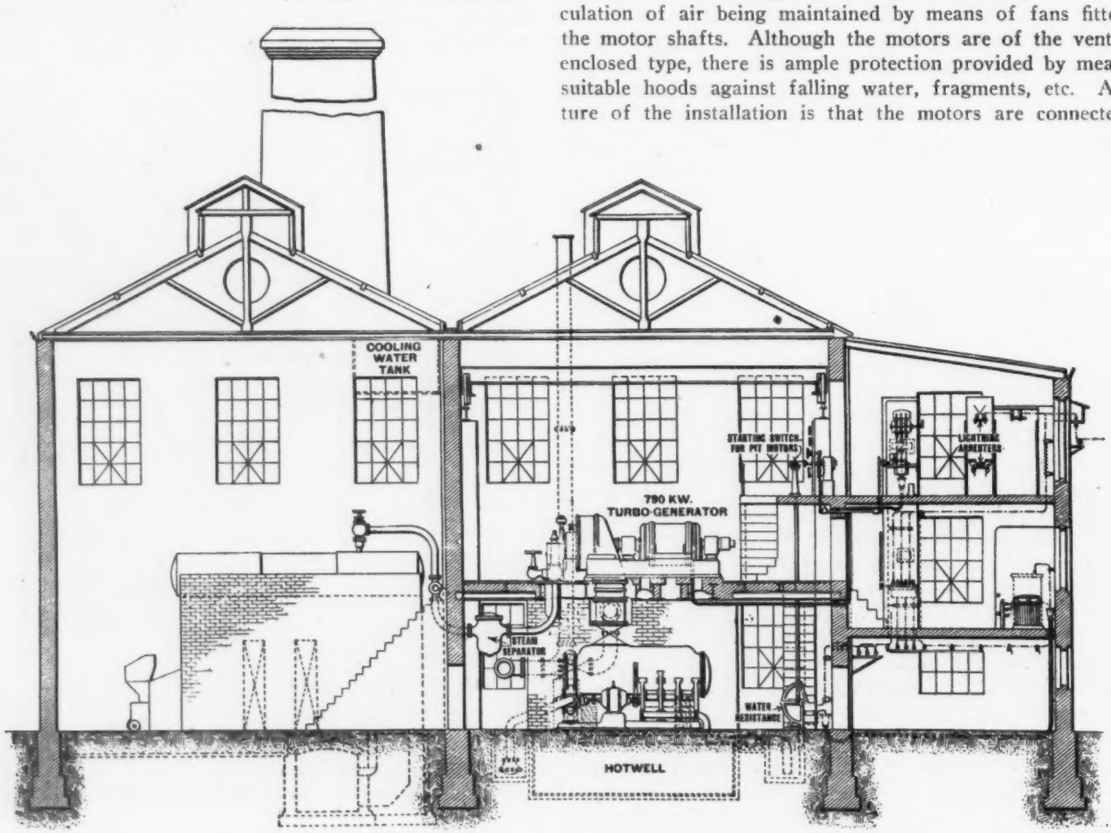


FIG. 4.—SECTIONAL ELEVATION OF POWER STATION.

The cables used for conducting the electricity to the motors in the pits are of special flexible pattern. Pure and vulcanized rubber is used for insulation, the rubber being selected so as to render the cables safe for a constant working pressure of 3000

volts between phases, a wire armoring being also used for a protection to the rubber. The cable for each motor is wound on its respective cable drum, one end being connected to the slip rings on its shaft, the other end being connected through a watertight junction box, fitted on the side of the motor, direct

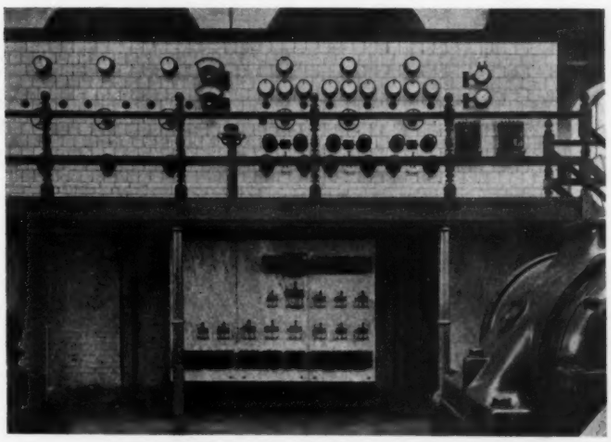


FIG. 5.—SWITCHBOARD, LINDAL POWER STATION.

to the motor terminals. By means of this arrangement the cable is paid out as the motor is lowered down in the pit and the whole of the live cables and terminals are effectually sealed and protected.

GENERATING STATION.

In order to provide electricity, a generating station has been built a short distance from Lindal Station, on the Furness Railway. The distance from the generating station to the three pits is: Lowfield, 980 yards; Berkune, 800 yards, and Diamond, 1720 yards. A three-phase system was adopted, and in order to transmit the required energy without undue loss and at the same time have a working pressure which could be applied directly to the motors, an e. m. f. of 3300 volts, with a frequency of 50 cycles, was chosen. The arrangement of the generating station is shown in Figs. 3 and 4.

Electricity is generated in three turbo-generators of the horizontal type, each set being capable of a continuous output of 1140 kilowatts when running at 3000 r. p. m. and supplied with steam at 200 lbs. pressure and superheated to a temperature of about 600 deg. F. Each turbine exhausts into a surface condenser. It may be mentioned here that the turbine used is of

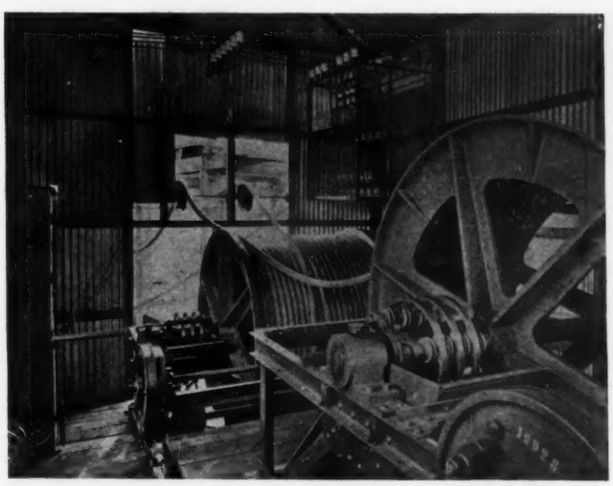


FIG. 6.—SUB-STATION AT LOWFIELD PIT.

the velocity type, steam being expanded and its pressure energy transformed into velocity energy in two stages, each pressure stage having two velocity stages. Steam is expanded from boiler pressure to about atmospheric pressure in the first set of nozzles, from which it passes through the first set of blades and guides. It is then further expanded in the second set of nozzles, whence it passes through the second set of blades and guides directly into the condenser.

The generators are of solid construction, the rotating field magnet structure possessing the characteristic of a solid cylinder. By a system of ventilation and by water circulation in a double casing round the stator and bearings, the generator is kept quite cool. The circulating water flows by gravity from a tank situated above the engine room. Eleven gallons of water is circulated per minute. The generator also runs with very little noise, owing to the construction of the stator. Each generator has its exciting unit direct-coupled to the main shaft and by means of a Tirrill regulator the terminal voltage is kept constant irrespective of load fluctuations. The guaranteed steam consumption is 18.2 lbs. per kw-hour.

The boiler plant consists of three B. & W. water-tube boilers, each of which is fitted with a superheater. The furnaces are equipped with automatic stokers driven by a three-phase motor. Feed-water is passed through a Green economizer.

The generator and feeder circuits are controlled from a main

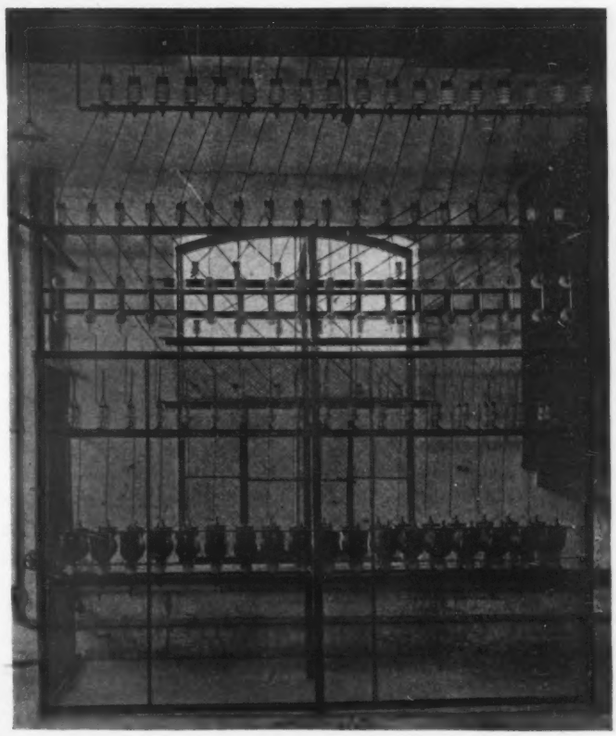


FIG. 7.—LIGHTNING ARRESTERS AT POWER STATION.

switchboard, Fig. 5, of special cellular design. The front of the board is constructed of tiled masonry, upon which the instruments are mounted, the switches being operated by hand-wheels. The connections are made to the switchgear by means of spindles passing through the wall. A feature of the control arrangements is that each of the six pit motors is under the control of the power-station engineer, the starting and stopping operations being carried out at the main switchboard.

Two sets of bus-bars are provided, one set for feeding the motors under full pressure, and the other set for gradually raising the pressure at starting. The starting is effected by two transformers connected in series. One of these is an auto-transformer, which gives a voltage half as large as the working e. m. f.; the second transformer has its primary winding connected in series with the auto-transformer and its secondary winding connected to a water rheostat, which is gradually short-circuited on starting the motors. By this means the e. m. f. applied to the motors at starting is gradually increased and all large rushes of current which might affect the voltage regulation avoided. As soon as the motors come up to speed, they are switched from the auxiliary bus to the main bus by

means of change-over switches of the oil-break type. To protect the motors against overload, each line is provided with automatic maximum-current circuit breakers. The handwheels operating the oil switches are connected to these circuit-breakers by means of trip gear, the latter being operated by solenoids fed direct from the busses. The relays controlling the circuit breakers are fed through series transformers, and as soon as the current exceeds a predetermined maximum, the solenoid circuit on the oil switch is closed and the switch is thereby opened by means of powerful springs. The relays can be fitted either for instantaneous operation or with a time element.

The switching arrangement, it will be seen, is centralized, the only apparatus at the pit heads consisting of an isolating switch in each case, with a voltmeter to indicate when the line is alive or dead. To permit the motors to be controlled from the power house, a separate transmission line of bare copper is run to each motor, the conductors being carried on porcelain insulators fitted on channel-iron cross-arms fastened to wooden poles. Fig. 7 shows the arrangement of the lightning arresters at the power house.

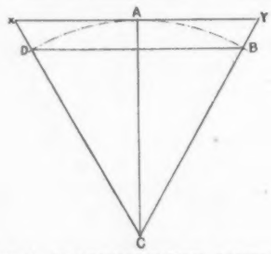
At the point where each transmission line terminates at the pit-head sub-station, the bare copper wires are connected to vulcanized rubber cables through a junction box mounted on the transmission line pole. The cables are in turn connected through the isolating switch and collecting brushes to the slip-rings of a specially devised cable drum, Fig. 6. The isolating switches are, in addition, arranged with mechanical devices by means of which the men in the pits in charge of the pumps can, in case of emergency, immediately disconnect the motors from the mains.

A complete telephone system has been installed between the power house and the various pits, whereby the necessary communications can rapidly pass between the engineer in the power house and his staff at the various stations.

The Lindal Moor Mines property covers about 3000 acres, which may now be developed on a scale hitherto impossible. Electrically-driven pumps have given results in mine working unattainable by any other method, and while direct-current motors have been employed to a great extent in British practice, polyphase motors have been extensively employed elsewhere, especially in connection with centrifugal pumps. The Electrical Company, Ltd., were the contractors for the entire installation.

Combined Two-Phase and Three-Phase Transformation.

The accompanying illustration indicates graphically a scheme for obtaining two-phase and three-phase electromotive forces simultaneously from only four wires, for which a patent was issued to Mr. W. T. Taylor on Oct. 29. In this illustration *C*, *x* and *y* are the terminal e. m. f. points of three delta-



TAYLOR TRANSFORMATION SCHEME.

connected transformers. Instead of obtaining three-phase e. m. f.'s from these three points, e. m. f.'s of less value in true three-phase relation are obtained from points *C*, *D* and *B*. The locations of *B* and *D* are so selected along the respective transformer windings that the e. m. f. *CD* or *CB*, is equal to the e. m. f. *AC*. Therefore, the e. m. f. *DB* is equal to the e. m. f. *AC*, and since it is in time-quadrature therewith the four points *A*, *B*, *C* and *D* give e. m. f.'s suitable for use with two-phase (independent windings) apparatus.

A Phenomenon of Revolving-Field Generators.

By F. Punga and W. Hess.

The treatment below deals with a phenomenon found in single-phase and polyphase generators, whose unpleasant consequences have been felt in many instances, but whose exact nature has not previously been investigated. The phenomenon relates to the small e. m. f. that is sometimes produced between the ends of the shaft of a high-speed machine; the layer of

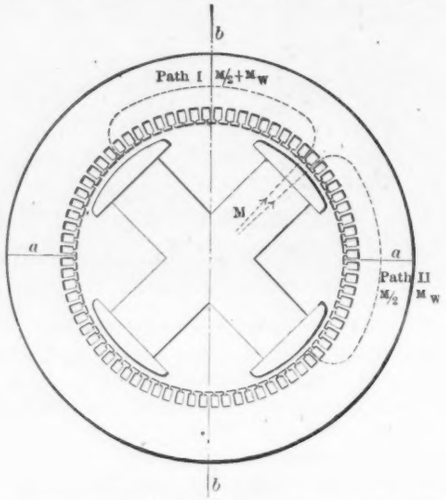


FIG. 1.—POSITION OF ROTOR GIVING NON-UNIFORM RELUCTANCE.

oil in the bearings forms a good insulator for the low e. m. f. so that no opposing current is produced by the e. m. f. The e. m. f. corresponds in frequency to the normal frequency of the generator, and in large high-speed machines its value is such that the bearings must be completely insulated from the bed plate of the machine. The cause for this e. m. f. is discussed below.

Figs. 1 and 2 show a four-pole generator, in which the stationary armature core is built in two parts. Magnetically there exists two small slits (air-gaps) at *a* and *a* in the arma-

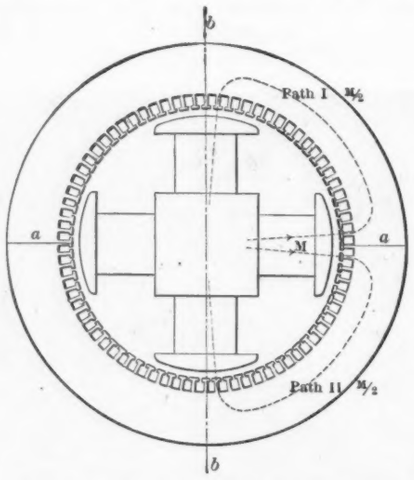


FIG. 2.—POSITION OF ROTOR GIVING UNIFORM RELUCTANCE.

ture ring. In Fig. 1 the rotor field core has such a position that there exists a maximum magnetic density through the slits *a* and *a*. However, the actual flux will be less through path *II* than that through path *I*, because the reluctance of the latter path is less than that of the former. Assuming that *M* is the value of the flux from each pole, expressed in megalines, then the flux in path *I* will be $(M \div 2) + m$ and that in path *II* will be $(M \div 2) - m$, *m* depending in value upon the reluctance of the slits.

In Fig. 2 the field core has such a position that the slits *a* and *a* have no effect on the distribution of magnetism, and the magnetism in each path is $(M \div 2)$. Evidently the effect is the same as though a flux of *m* megalines passed perpendicularly to the armature shaft, and alternated at the frequency of the terminal voltage. Assuming a sinusoidal time rate of change of the flux the actual value of the e. m. f. between the ends

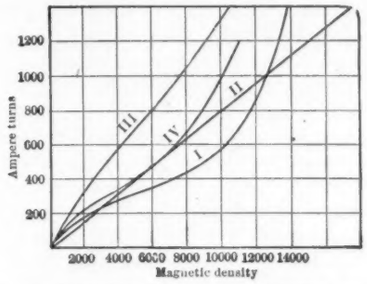


FIG. 3.—MAGNETOMOTIVE FORCES FOR VARIOUS SLIT-WIDTHS.

of the shaft will be, in volts, $E_s = 4.4\,fm\,10^{-8}$, where *f* is the frequency in cycles per second.

An actual example may be used to show the true magnitude of the e. m. f., E_s. In the accompanying table values are given for a certain four-pole generator in which the width of the slit

Excit. Current	Megalines Per Pole	Lines per sq. c.m. Mean	Max.	Min.	Volts Calculated	Observed
20	14.5	2,590	3,800	1,380	5.00	5.3
40	27.3	4,870	7,300	2,490	10.00	10.5
60	39.7	7,100	10,200	4,000	12.75	12.0
80	47.0	8,400	11,300	5,500	12.00	12.0
100	52.0	9,300	12,000	6,600	11.00	12.0
120	56.0	10,000	12,500	7,500	10.30	12.0

(*a* of Fig. 1) was 1 mm. Column 1 gives the exciting current; column 2, the magnetic flux per pole by test; column 3, the magnetic density in the armature on the assumption of uniform distribution of the flux.

In Fig. 3 the abscisssæ represent magnetic density and the ordinates the required ampere-turns of m. m. f. Curve I is for the path of the flux in the armature from one pole to another; a length of 113 cm through the iron sheets is obtained from the design sketch of the machine. Curve II shows the ampere-turns for a slit-width of 1 mm. Curve III, the ordinates of which are the sum of the ordinates of curves I and II, gives the ampere-turns for the total path when there is an added slit of 1 mm. Curve IV shows the mean flux for each value of excitation. By use of the above table and curve IV one can readily determine the maximum and minimum density in the field core. Finally, the density of the flux *m* has a value of $(B_{max} - B_{min}) \div 2$. The cross-section is 2750 sq. cm; the

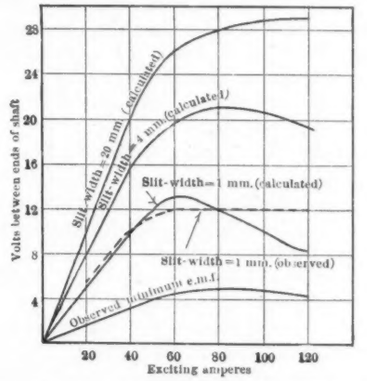


FIG. 4.—EXCITATION CHARACTERISTIC FOR VARIOUS SLIT-WIDTHS.

frequency *f* is 33.3; so that all values are available for the determination of the e. m. f. between the ends of the shaft by means of the formula above. In Fig. 4 this e. m. f. is plotted as a function of the exciting current. Values are given for slit-widths of 1 mm, 4 mm and 20 mm, and also the measured e. m. f. for an air-gap of 1 mm. As previously noted, the determinations were based on a normal magnetization curve for iron, and the deviation at the higher density indicates that the permeability of the iron was actually somewhat better than assumed. The e. m. f. was also measured when the two halves of the stator were placed directly in contact with each other. As is well known, even when the halves are placed upon each other as closely as possible the slit-width (air-gap) does not reduce to zero. The tests seem to indicate that the unavoidable contact reluctance corresponds to an air-gap of ¼ mm. A comparison of the two curves shows that the maximum e. m. f. of 4.6 volts with a .25-mm gap increases to 12. volts with a 1-mm gap. For a 4-mm gap the maximum e. m. f. is 20.5 volts, and with a 20-mm gap the e. m. f. reaches 29 volts. In Fig. 5 the maximum e. m. f. is plotted as a function of the slit-width (air-gap) in mm; it is seen that with the chosen

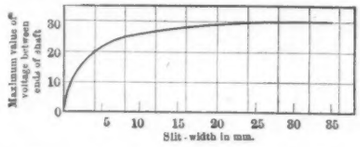


FIG. 5.—VARIATION OF E. M. F. WITH THE WIDTH OF THE SLIT.

machine the e. m. f. between the ends of the shaft (at 33.3 cycles) may reach 30 volts.

Fig. 6 gives an oscillograph record of the e. m. f. between the ends of the shaft when the slit-width in the magnetic ring had its minimum value.

It is interesting to determine what the results will be with a machine having a different number of poles than four. If there are two slits in the magnetic path then there can be no e. m. f. between the ends of the shaft of a two-pole machine; in case an e. m. f. does appear, it may be attributed to the irregular magnetic reluctance of the laminations. On the other hand, an e. m. f. will be produced between the ends of the shaft on any machine whose number of poles is divisible by four when there are two parts to the magnetic ring. It can be shown also that a machine having $2p$-poles in which the magnetic ring is divided into n equal parts will possess an e. m. f. between the ends of its shaft if $2p \div n$ is an even number. The question naturally arises as to the method by which the disadvantageous e. m. f. between the ends of the shaft may be overcome. An obvious remedy is to make the magnetic reluctance of the slit (air-gap) in the ring as small as possible; it is impossible, however, to decrease the reluctance to zero. An effective cure is found in making the number of slits in the ring such that $2p \div n$ is not an even number, and thereby insuring that the various flux paths will have equal reluctances. For example, a four-pole machine could have two horizontal and two vertical slits in the magnetic ring.

It is possible to make use of the e. m. f. between the ends of the shaft to obtain a special form of high-speed, low-voltage, alternating-current generator. This machine has no armature winding, and need not have slots; the stator discs are arranged in p sections, separated from each other by a slit (air-gap) or any non-magnetic material. The shaft itself serves as an armature winding, a large number of copper brushes being used for collecting the current. The bearings, or the bearing stands, are thoroughly insulated from the ground.

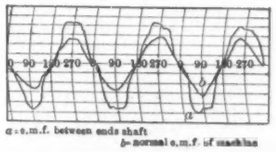


FIG. 6.—OBSERVED E. M. F. BETWEEN ENDS OF SHAFT AND NORMAL E. M. F.

Although the machine would hardly be considered for practical operation, yet it may prove of interest to compare its performance with that of a normal machine. The no-load excitation characteristic is sufficiently well shown in Fig. 4. It will be noted from Fig. 5 that the width of the slit in the stator ring after reaching a certain value is almost without effect upon the no-load e. m. f. With regard to the armature

reaction, as will be seen below, it is absolutely necessary to take a very large value for the gap.

The armature reaction exhibits itself at three different points: (1) in the yoke, (2) in the stator proper, and (3) through the stator and the pole faces; the various paths are indicated in

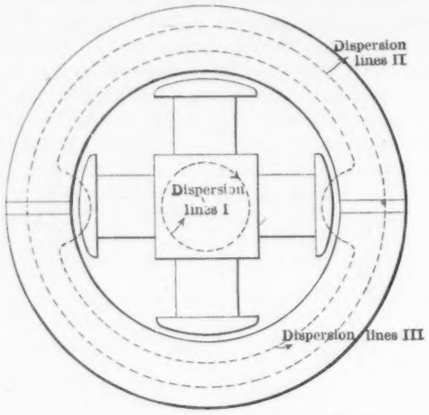


FIG. 7.—PATHS OF DISPERSION FLUX.

Fig. 7. It is to be noted that with a load current of I amperes, the armature m. m. f. is I ampere-turns, the armature winding consisting of a single turn.

The first path, in the case of a massive yoke, would permit the formation of considerable eddy currents; on the other hand, if the path is laminated the magnetic reactance will be large. There are two methods of overcoming these difficulties: either the yoke can be provided with copper damping devices in which the loss will be small, or the poles and the yoke can be frequently subdivided as shown in Fig. 8.

The second path (Fig. 7) follows the periphery of the stator, and encounters only the reluctance of the joints; it is desirable to ascertain its effect upon the operation of the machine. Consider, therefore, a two-pole, 50-cycle machine having a flux of 30 megalines per pole and an e. m. f. between the ends of the shaft of 30 volts. It is required to determine the width of the stator-slit when the reactive e. m. f. caused by the flux following path *II* will be 5 volts at a load of 8000 amperes. From the familiar transformer e. m. f. formula, $E = (4.4 f n \phi_m) \div 10^8$, $5 = 4.4 \times 50 \times 1 \times M \times 10^{-8}$, hence $M = 2.2 \times 10^8$; 2.2 megalines must follow path *II*. The total

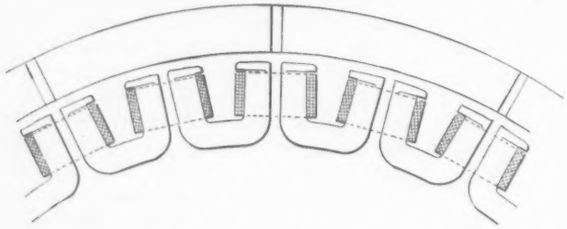


FIG. 8.—ARRANGEMENT OF POLES TO MINIMIZE REACTANCE.

reluctance of the periphery may be considered as merely that of the slit whose width is l cm. Let the cross-section of the path be q sq. cm.

Then, approximately,

$M = 2.2 \times 10^8 = (4\pi niq) \div 10l = (1.25 \times 1 \times \sqrt{2} \times 8000 \times q) \div l$; $2.2 \times 10^8 l = \sqrt{2}\, 10^4 q$; hence $l = q \div 155$.

Assuming a cross-section, q, of 1770 sq. cm, l becomes 11.5 cm. That is to say, the slit should have a width not less than 11.5 cm to obtain the desired performance.

The third path (Fig. 7) is along the leakage route formed by the pole face when it is adjacent to the stator slit. The leakage field through this path can be reduced by using a larger air-gap, a change that will necessitate an increase in the main exciting m. m. f.

The determination of the characteristics of a multipolar machine is made exactly as has just been done for a two-pole machine, except that the current strength should be divided by the number of pairs of poles—that is, by the number of stator slits.

It is noteworthy in this connection that in a machine with a rotating armature, an e. m. f. will be generated between the

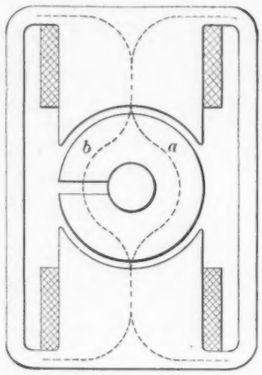


FIG. 9.—REVOLVING-ARMATURE COILLESS GENERATOR.

ends of the shaft if a radial slit is cut in the armature discs, as indicated in Fig. 9. The flux will vary with the position of the armature and will swing across the shaft and generate an e. m. f. therein. The authors have as yet not made a test on such a generator.

Direct-Current Turbo-Generators.

By H. I. C. Beyer.

The direct-current turbo-generator differs in many respects from machines of the low-speed type. In fact, it is of all machines the most difficult to construct. The following outline of the constructive features of such machines may prove of interest to designing and constructing engineers. Only those machines which possess commutating poles and compensating windings will be considered, because for large ratings no other types of generators are satisfactory.

In designing the armature the problem arises as to the proper number of coils to use per slot. The investigation of this problem shows that in high-speed generators there should be not more than two conductors per slot. The facts upon which this conclusion is based were discussed by the writer in the issue of *Elek. U. Masch.* (Vienna), for Oct. 6, 1907.

Experience shows that the e. m. f. between adjacent commutator segments should not be greater than 25 volts; it is preferable to keep the e. m. f. below 20 volts. By the use of compensating windings or slotted poles with highly saturated pole-teeth the e. m. f. between segments will remain constant at all loads.

On account of the fact that the cooling surface of the armature in most cases will be large enough to prevent the temperature elevation from reaching an excessive value even when the iron loss per cubic inch is high, the actual frequency of reversal of magnetism and the loss occasioned thereby is not a determining factor in selecting the number of poles. The choice of the number of poles depends largely upon the maximum permissible e. m. f. between the commutator segments and maximum permissible peripheral speed of the armature.

Assume, for example, a 250-kw, 550-volt, 3000-r. p. m. machine having a pole arc equal to six-tenths of the pole-pitch. The minimum number of segments between neutral points would be $(550 \div 25)\ (1 \div 0.6) = 36$. If the machine be constructed with four poles, the total number of segments will be $4 \times 36 = 144$. With two bars per slot there would be 144 slots in the armature. The armature conductor should have a section of 3×10 mm. By calculation the slot pitch is found to be about 14 mm so that the circumference is $.014 \times 144 = 2.02$ m and the peripheral velocity $(2.02 \times 3000) \div 60 = 101$ m per

second, which velocity is much too high. The machine must, therefore, be constructed with two poles, in which event the peripheral velocity can be lowered to about 70 m per second, and the maximum e. m. f. between segments may be lowered to about 20 volts. It is seen, therefore, that the machine will be improved by employing two rather than four poles, although the cost will be higher.

From the foregoing example it is evident that a disadvantageous limiting condition is imposed by the requirement of not more than two bars per slot. For machines rated at 1000 kw or more the two-pole construction results in a monstrosity. In such a case the limitation may be removed by employing "intermediate segments," as shown in Figs. 1 and 2, connected to the rear ends of the armature bars. By this construction the e. m. f. between segments decreases to one-half of the former value, and the machine can advantageously be built with four poles. The distance between brushes will be adequate on account of the required large diameter of the commutator of large machines. In order to make the reactance of the connecting wire as small as possible, the armature spider should be constructed of non-magnetic material. It will seldom be possible to use more than four poles. However, when the speed is low enough or the e. m. f. is low, a six-pole machine can be operated with satisfactory results.

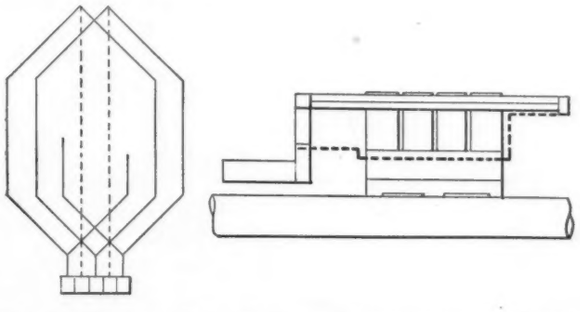
As a substitute for the "back-connecting wires" use may be made of interposed armature coils formed of wire of small diameter. One end of each coil is connected to one of the main segments, while the other end is connected to an intermediate segment.

The determination of the reactance e. m. f. is made as simply as possible, because the commutating field can be adjusted experimentally. It is necessary merely to make the commutating field equal to twice the reactance field at each load current, because during commutation the reactance field changes from a certain positive value to an equal negative value.

The fact should not be overlooked that during the commutation period the armature teeth are opposite a pole face. It is advantageous to use solid pole shoes, and also to place a plate of copper over the pole face so that the eddy currents produced therein reduce the reactance field and improve the commutation.

The problem as to the maximum permissible value for the amperes per armature conductor for high-speed machines has not yet been definitely solved. Experience indicates that a current of 750 amperes per conductor at normal load may be employed in a machine revolving at 3000 r. p. m. and using simple metal brushes and yet the commutation will be satisfactory.

The selection of the form of the slots depends upon the same factors encountered in the ordinary direct-current dynamos. Special efforts must be made to render the wedges strong. The wedges may advantageously be constructed of hard-fiber fish-paper or wood. For narrow slots, the form shown at I in Fig. 3 may be used; when the slots are wide form II may be used. The strongest construction is shown in form III. Moreover, with the last form the advantage of a small slot opening is obtained; each armature conductor should be made up of two separate parts without individual insulation, the two parts being insulated as a unit after being dropped into place.



FIGS. 1 AND 2.—ARRANGEMENT OF INTERMEDIATE COMMUTATOR SEGMENTS.

Fig. 4 will serve for illustrating the variation of flux in the armature iron and thereby ascertaining the iron loss. The magnetic density in the armature core varies from a positive maximum at cross-section IX to a negative maximum at XI. The periodicity of the flux variation is determined from the number of main poles and the rotative speed, just as is true with machines without commutating poles. In the teeth, however, the magnetic cycle is not so simple. The magnetic density

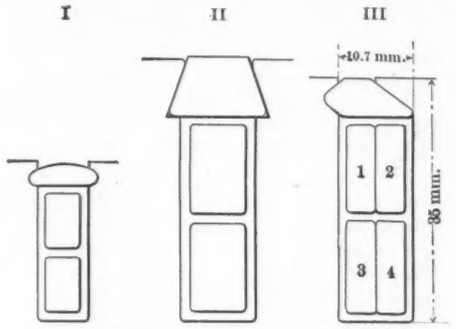


FIG. 3.—ARRANGEMENT OF SLOTS AND RETAINING WEDGES.

in the teeth varies from a positive maximum under a main pole through zero to a negative maximum under an auxiliary pole; the density then decreases to a certain minimum between the auxiliary pole and the next main pole of the same polarity, and then increases again to the maximum under the main pole. The action is, therefore, somewhat complicated. It is possible to determine the losses in the teeth approximately by finding the value of the loss which would be caused if the auxiliary poles alone were active and then finding the value of the loss attributable to the main poles alone, and adding these two losses.

The mechanical details of the machine must be designed and constructed with great care. For small and medium-sized machines the armature laminations may be mounted directly upon the shaft. In this event the discs must be mounted with extreme accuracy. Ventilating ducts should be provided near the shaft. Large armatures should be built with bronze or steel spiders. Air ducts about 8 mm in width should be placed along the armature at intervals of from 30 to 50 mm. The armature end-discs should be constructed of bronze. These discs can simultaneously serve as supports for the windings.

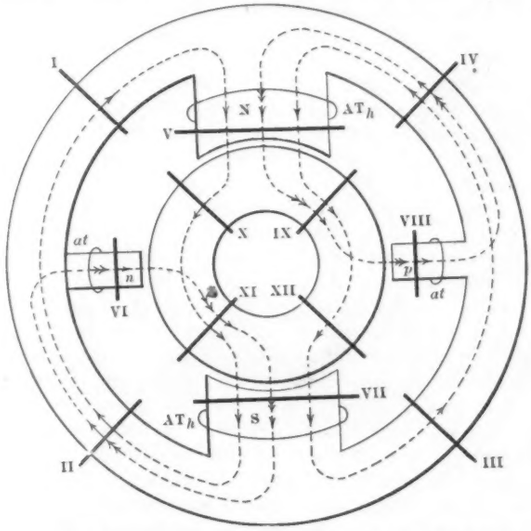


FIG. 4.—DISTRIBUTION OF MAIN-POLE AND COMMUTATING-POLE FLUX.

Fig. 5 shows a longitudinal-section of an armature for a four-pole 220-kw machine designed for 2600 r. p. m. and 110 volts. It will be noted that the armature conductors are

soldered at the rear; this arrangement prevents the lower conductors from being bent by the centrifugal force.

The insulating material should be flawless and of high mechanical strength; it should possess a minimum compressibility.

The shape of the armature conductors should be such that they fit the cylinder perfectly before the binding wires are applied. The conductors should first be held securely by temporary bands, before the final binding wires are applied. When temporarily banded the whole should act as a solid mass when struck a hammer blow.

A good form of binding material is found in American bronze wire. Each band should be made from a single length of wire without joint. Steel wire should never be used on account of the heat produced in it by the leakage magnetism.

One of the most important features of the process of applying the binding wires is the tension used. A special machine is employed by the A. E. G. of Berlin. An indicator which makes a record on a strip of paper shows the exact tension used. The binding wires should be so designed that at a speed 25 per cent above normal the "factor of safety" will be about 5. When the binding wires have been properly applied, no trouble is to be feared from "creeping." The diameter of the wire should be at least 2 mm. The ends should be soldered in place with the aid of numerous sheets of copper, exactly as is done with low-speed machines.

Between the commutator necks and the bronze end-cylinder, the distance should be at least 50 mm for a 250-volt machine and 80 mm for a 500-volt machine.

Extra care must be used in the design and construction of

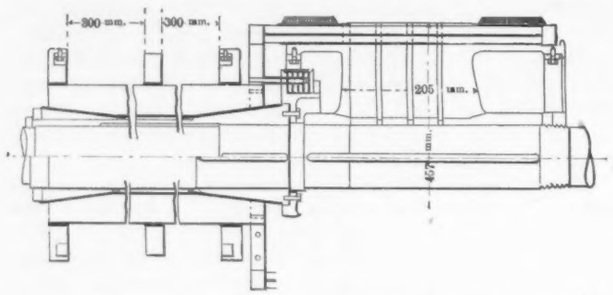


FIG. 5.—LONGITUDINAL SECTION OF A 200-KW, FOUR-POLE, 2600-R. P. M. DIRECT-CURRENT GENERATOR.

the commutator. With an e. m. f. of 25 volts between segments the mica should be 1.5 mm thick; with 20 volts the thickness should be 0.8 mm. The insulation under the shrink-rings should be of mica; its thickness should be 8 mm for 500-volt machines, and 5 mm for 250-volt machines.

The peripheral speed of the commutator should not exceed 40 meters per second. The segments should be given such a height that when they have become worn for a radial depth of 20 mm they will not bend outward. The shrink-rings must therefore be given such a strength and be so disposed that at a speed of 25 per cent in excess of normal the segments will not bend. It has been found that with segments from 50 to 60 mm in height on a commutator about 300 mm in diameter there may be a clear distance of 300 mm between the shrink-rings. The segments should be made of hard drawn copper.

The life of the commutator depends to a large extent upon the material of which the brushes are made. Carbon brushes should not be used upon a cylindrical commutator at very high peripheral speeds, because the commutator is sure to vibrate, and the springing of the brushes will cause sparking. Of the several metallic brushes, the copper-graphite brush and the straight-wire brush have proved satisfactory. The former brush keeps the commutator in better condition than does the latter. However, it requires a more nearly perfect commutator because the brush is not so pliable as the wire brush. Moreover, when the straight-wire brush is used the commutating field need not be so closely correct as when the copper-graphite brush is used.

Excellent results are obtained when use is made of both carbon and metallic brushes in combination. An arrangement of this kind is shown in Fig. 6. The carbon is placed practically at right-angles to the metallic brush. A disadvantage of this arrangement is found in the fact that the springs *a* and *b* act in opposite directions, and the distribution of the pressure is indefinite. An improvement is indicated in Fig. 7, where the holder for the carbon is rigidly attached to the brush spindle. The clamp for the carbon brush is built as a hinge so that each holder is independent of the other. The carbon brushes serve

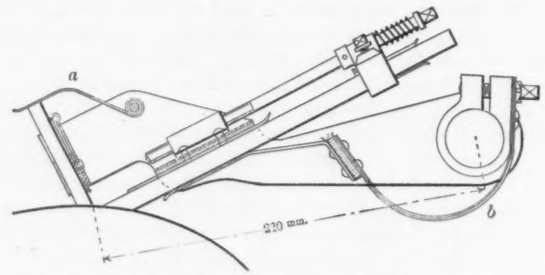


FIG. 6.—HOLDER FOR CARBON AND COPPER BRUSHES.

merely for improving the commutation, and not for conveying the main-line current. In order, however, to prevent the spring *c* from being heated by current, it is desirable to connect the carbon directly to the metal part of the holder. Faultless commutation can be obtained when the current density is 25 amp. per sq. cm of the contact of the metallic brushes. It is advisable, however, not to exceed 20 amp. The cross-section of each metallic brush should be at least 50 x 8 mm. The carbon brush should have approximately the same cross-section.

The distance between the outer holder and the shrink-ring for a 500-volt machine should be at least 30 mm. The tendency to "flash over" from brush to brush is especially pronounced when a 500-volt machine without compensating winding or highly saturated pole tips is subjected to a suddenly applied overload, on account of the high e. m. f. between segments due to the cross flux. For the purpose of preventing the "flash over," Parsons arranges the brushes in two groups, the negative brushes being placed on one side of the commutator and the positive on the other. This arrangement is disadvantageous in that it requires a commutator of double the normal length. Moreover, it does not entirely eliminate the "flash over," because it can form between one brush and a shrink-ring and from this ring to the opposite brush. It is possible to place a stationary insulating ring between the brushes and the shrink-rings, and a separate shield between the brushes of opposite polarity; it is possible, also, to isolate each brush thoroughly in its own insulating compartment.

The brush rigging should be especially rigid. It is advan-

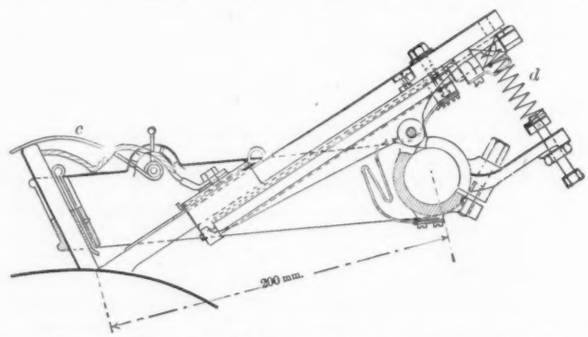


FIG. 7.—IMPROVED HOLDER FOR CARBON AND COPPER BRUSHES.

tageous, particularly with large machines, to mount the rigging separate from the machine body and bed plate. The brush spindles should be fastened at both ends to massive iron rings. The insulation used should have very large surface on account of the unavoidable collection of carbon and copper dust which may form a conducting path between the iron rings and the brushes. The two rings should be mounted in their own sup-

ports and be arranged to be rotated by means of worm-gearing.

It has been suggested to arrange the commutator upon its own shaft with separate bearings and bed-plate. By this arrangement the vibrations of the armature do not reach the commutator, and it is permissible to use carbon brushes. If the commutator could be built without leads, this solution would be a good one. Moreover, in case nothing prevents, the diameter can be made smaller, because the shaft need not be large.

It has been shown by Seidener that a large part of the loss at the brushes may be attributed to the vibrations occasioned by the eccentricity of the surface of the commutator. The vibrations of the brushes may be minimized by placing them sidewise against a radial commutator, as has been done by the British Westinghouse Company with good results. This arrangement is shown in Fig. 8, where shrink-rings are used on the outer circumference of the segments, and in Fig. 9, where steel bands are placed in the grooves. In order to obtain the advantages of shrink-rings with the form shown in Fig. 9,

FIGS. 8 AND 9.—ARRANGEMENT OF DISC COMMUTATOR AND RADIAL BRUSHES.

Miles Walker devised the ingenious scheme shown in Fig. 10. Each band was wound in a four-part U-shaped ring. After the rings were wound as solidly as possible, transformer-core material was built up around them. Alternating current being sent through a conveniently located solenoid, a large secondary current was produced in the bands. In this way the temperature of the bands was raised until they were red-hot, when they were moved over to the extreme right (Fig. 10). When the bands were allowed to cool off, the commutator possessed great solidity. A difficulty of this kind of commutator is found in the necessity for insulation around each steel ring. Moreover, the peripheral speed of the outer part of the discs is somewhat high.

Tests have shown that at high speeds, the current density may be 10 amp. per sq. cm with soft Morganite carbon brushes; with hard carbon brushes the density should be somewhat less. The radial-disc commutator is considerably more costly than

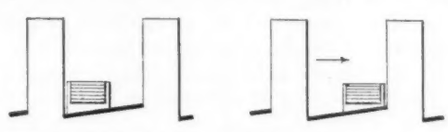


FIG. 10.—METHOD OF APPLYING SHRINK-BANDS.

a cylindrical one, but a compensating advantage is found in the ability to use carbon brushes. A generator using a commutator of this type is now being built by the British Westinghouse Company. This machine is rated at 1000 kw, 600 volts, 1500 r. p. m. and has four poles.

The stationary and revolving members of a 375-kw, 2500-r. p. m. machine built by the above-mentioned company are shown in Figs. 11 and 12, respectively. The machine is a four-pole generator provided with a shunt winding for 230 volts at no load, and a series winding for compounding to 240 volts at full load. The inner diameter of the armature core is 298 mm, the outer diameter is 560 mm and the bore of the field core is 580 mm. The total net axial length of the armature is 305 mm; there being six 8-mm air ducts, the real length is 257 mm; allowing 10 per cent for insulation, the effective iron length is 230 mm.

The armature has 72 slots, each 10.7 x 35 mm in section (see III of Fig. 3). There are two conductors per slot, each

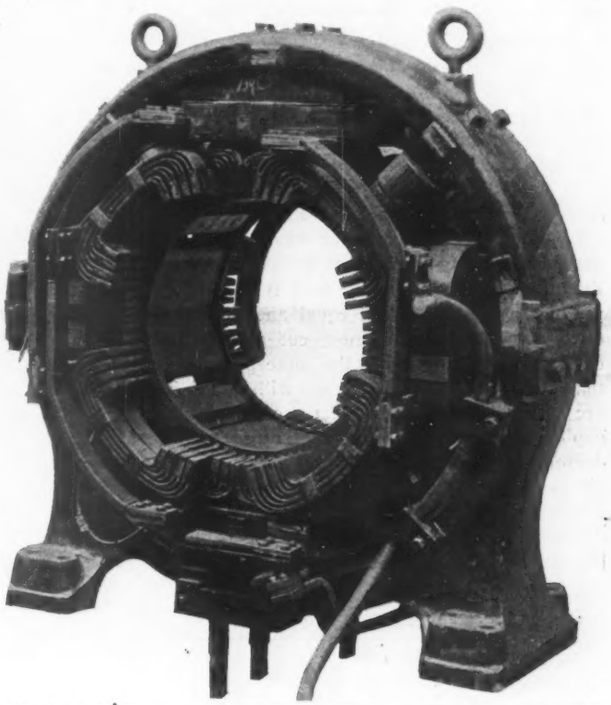


FIG. 11.—STATOR OF A 375-KW, 2500-R. P. M. DIRECT-CURRENT GENERATOR.

consisting of two bars in parallel, the cross section of each being $4 \times 12.7 = 50$ sq. mm; thus the copper area per conductor is 100 sq. mm. The total number of conductors is 144. The winding is connected in "lap," the rear "throw" being slots 1 and 19, the front 19 and 2.

The commutator has 72 segments. Its diameter is 305 mm. The total length of the segments is 880 mm. Four shrink-rings, each about 40 x 70 mm, serve to hold the segments together. There are nine metallic brushes per holder, each having a cross-section of 35 x 8 mm. These brushes are combined with nine carbon brushes 35 x 8 mm, as shown in Fig. 7.

The peripheral speed of the armature is 73 meters per second, and that of the commutator 40 meters.

The machine shows a total e. m. f. drop at the brushes (including the drop in the brushes themselves) of 4.6 volts. The e. m. f. under load is, therefore, 245 volts. There are,

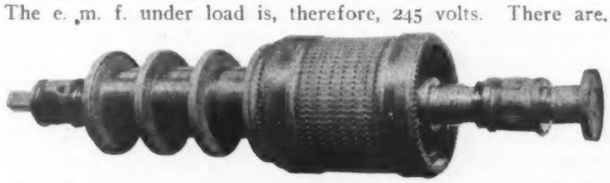


FIG. 12.—ROTOR OF A 375-KW, 2500-R. P. M. DIRECT-CURRENT GENERATOR.

therefore, 4.1×10^6 lines of force per pole. The pole-face factor is .61. Under each pole there are 11 teeth the total cross-section of which is 270 sq. cm. Therefore, the flux density is 15,200 lines per sq. cm. In the armature body, the cross-section of which 2 x 220 sq. cm. the flux density is 9300.

The current per armature path is 400 amp.; thus the current density in each armature conductor is 4 amp. per sq. mm. The current per slot is 800 amp. The ampere-conductors per centimeter of circumference = 328. The current density in the metal brushes is 17 amp. per sq. cm.

The maximum e. m. f. between commutator segments is

21 volts. There are four bronze balancing rings connected respectively between segments 1 and 37, 10 and 46, 19 and 55, 28 and 64.

The shaft is 165 mm in diameter at the center. The armature discs are mounted directly upon the shaft as shown in Fig. 5.

The effective air-gap area is 730 sq. cm so that the air-gap flux density is 5600; the ampere-turns per pole is 4500 for the air gap. An approximate calculation of the leakage gives 15 per cent; the magnetic density in the pole core is 10,400 lines per sq. cm; the density in the yoke is 8000. Thus the ampere-turns for the pole iron is 150; for the yoke, 250, and for the armature iron 50. The total m. m. f. for the iron part of the path is 450 ampere turns, or 4950 ampere turns for the whole machine.

By taking into account the total flux which cuts across the conductor locally during the commutating period, it is found that the effective reactance field is 127,000 lines. In order to produce a speed e. m. f. equal and opposite to the reactance e. m. f. the conductor must cut across 254,000 lines of the commutating field during the same period. Assuming initially that the machine is to operate with metal brushes having an arc on the commutator of 1.5 cm, the pole arc at the air gap would be 2.8 cm, and within this arc the armature conductor must cut across 254,000 lines. The cross section of the air gap at the commutating pole being 76 sq. cm, the density of the commutating field at the air gap would be 3350. The depth of the air gap being 1 cm, the m. m. f. to produce the commutating field would be 2700 ampere-turns. The total pole

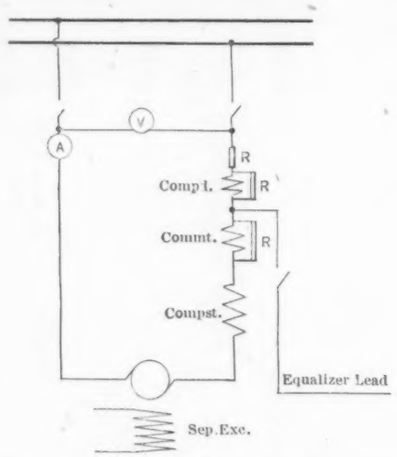


FIG. 13.—DIAGRAM OF GENERATOR WINDINGS.

arc has been made 6.3 cm and the total flux of each commutating pole is 600,000 lines.

The armature m. m. f. per pole is $(144 \times 400) \div 8 = 7200$ ampere turns. The main compensating winding should have $(328 \times 56 \times \pi \times 0.61) \div 4 = 8800$ ampere conductors. Since this winding carries 1600 amperes, there should be 5.5 conductors. The machine is built with 6 conductors per pole, each consisting of 2 rods 8 x 50 mm in cross-section; the current density is 2 amp. per sq. mm. In each pole face there are 9600 ampere-conductors. In order to compensate for the armature m. m. f., each pole must provide $7200 - (9600 \div 2) = 2400$ ampere-turns; that is, 1.5 turns at 1600 amperes. In order to produce the commutating field there must be additional m. m. f. of $(2700 \div 1600) = 1.7$ ampere-turns. Thus the total m. m. f. should be 3.2 ampere-turns, for perfect commutation with metal brushes. The machine as actually built contains only three turns. Under test the generator sparked somewhat and the air gap at the commutating poles had to be decreased to obtain sparkless commutation with metal brushes. In commercial service the machine is used with combined carbon and metal brushes, which cover a larger arc on the commutator than did the metal brushes, and thus the period of commutation is increased considerably. In fact it has been necessary to shunt 140 amperes from the commutating-pole circuit in order to obtain sparkless commutation at full load. The total flux per commutating pole is thus reduced from 600,000 to 422,000 lines, and the magnetic density to 2360.

A calculation of the leakage flux at the commutating poles gives 363,000 lines. The useful field is 422,000 lines, so that with a pole cross section of 70 sq. cm, the magnetic density in the pole body is 11,200 lines. The density in the yoke between a commutating pole and a main pole of opposite polarity is 10,000. In the armature core the density reaches a maximum of 11,200 lines

The losses in watts are distributed as follows:—See the diagram of connections, Fig. 13.

Armature iron loss	4,240
Brush friction loss	3,170
Brush I^2R loss	1,630
Armature I^2R loss	3,830
Compensating winding I^2R loss	1,425
Commutating pole winding I^2R loss (with shunting resistance)	404
Compound winding I^2R loss (with shunting resistance)	101
Shunt excitation winding I^2R loss	540
Regulating rheostat I^2R loss	228
Total loss	15,568
Output	375,000
Input	390,568

(Excluding windage and bearing friction.)
Net efficiency, per cent, 96.

The following temperature rises were observed by thermometer, the room temperature being 25 deg. C.

Surface of the armature iron	30 deg. C.
Surface of the armature end turns	33 "
Commutator	38 "
Commutating pole winding	22 "
Compensating winding	16 "
Shunt excitation winding	28 "

The above values were obtained when the machine was not enclosed.

If certain of the above values are inserted in the formula for the temperature rise, in degrees C.

$$T = \frac{W \cdot K}{A\,(1 + 0.3\sqrt{s})}$$

where W is loss in watts, A is the cooling surface in sq. cm and s is the peripheral velocity in meters per second, then the constant K has a value of 310 for the iron part of the armature when the outer surface of the armature cylinder is counted in full, and the air ducts and the inner surface are counted at one-half of their value. For the end turns of the armature windings K has a value of 375 when the outer surface is counted in full and the inner at half value.

When the temperature rise in deg. C. and the exposed surface in sq. cm and the watt loss of the shunt excitation windings are inserted in the formula,

$$T = \frac{W \cdot K}{A}$$

K is found to have a value of 600 when the surface adjacent to the iron is neglected.

The design in all of its details cannot be considered as ideal, yet there have arisen no causes for complaint and it has fulfilled every expectation. It could be improved somewhat by increasing the magnetic density in the body of the main poles to 16,000 lines per sq. cm—thereby obtaining a machine whose e. m. f. would be less sensitive to changes in speed and excitation—and by decreasing the pole-arc of the commutating poles from 63 mm to about 45 mm, thereby decreasing the magnetic density in the armature, the yoke and the commutating pole, and lessening the leakage.

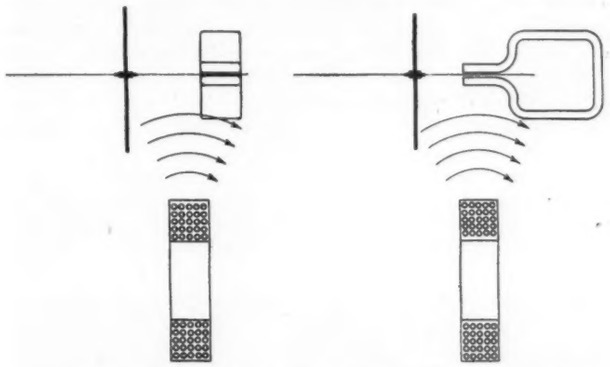
Effects of Short Circuits on the Drag Magnets of Watt-hour Meters.

BY A. A. RADTKE.

It is generally held to be true by meter men that the permanent magnets of meters are protected by the right-angle arrangement between the plane of the magnets and the flux emanating from the series coil of a direct-current watt-hour meter. That is, if a short-circuit occurs on the circuit to which the meter is connected, the magnetic blow on the permanent magnets will have a minimum effect. Referring to Figs. 1 and 2, the former is believed to be the arrangement that gives the most complete protection. It was upon this point that Duncan took out a patent claiming that the right-angle arrangement gave complete protection.

Recently it was my opportunity to be able to investigate the truth of this statement. The method employed was as follows: A watt-hour meter of 10 amperes rating was connected to a storage-battery circuit capable of maintaining a constant condition of operation with a load of several incandescent lamps. Above the retarding system there was mounted a set of coils duplicating the series coils of the meter, and connected in series with them was a fuse gap and a source of energy of large capacity.

In order to study the effect of various influences, a steady current was first sent through the upper coils and then removed, and any decrease or increase of rotative speed



FIGS. 1 AND 2.—EFFECTS OF SHORT CIRCUITS ON DRAG MAGNETS.

noted. This was done for a large number of values of current ranging from full load to 20 times that value, and this was accompanied by a change in the angular position of the upper coils varying from a right angle between the flux of the series coil and the plane of the magnets, to the position where the series flux was parallel to that of the permanent magnets. The result from these experiments showed that there was no change in the strength of the magnets for any position of the coils.

Fuses were then inserted in the gap provided and blown with the coil again in the various angular positions. This series of trials covered fuses up to 50 amperes in rating, and gave very definite results.

The conclusions drawn were the following: When a magnet of the form usually used in meter construction is subjected to a sudden impulse or blown from an intense field at right angles to the lines along which the molecules have arranged themselves when magnetized, the result is always a demagnetization of the permanent magnets; and that when the magnetic blow emanates from a field which is parallel to the flux of permanent magnets, there is always an increase in the strength of the magnets.

In the first case there is a flux passing through the magnet at right angles to the direction of the molecular alignment. Therefore, only forces are exerted which tend to destroy the arrangement of the molecules and with a resulting reduction in the strength of the magnet.

In the other case each of the two limbs of the magnet is traversed by flux from the blow, but the direction of this latter is different in the two portions of the magnet, as compared with the sense of the molecular alignments. In one limb the tendency is to strengthen the grouping of the molecules and in the other to destroy it; or, in other words, we have the two limbs subjected to separate magnetizing and demagnetizing forces. Inasmuch, however, as steel exhibits unequal changes in magnetic strength for equal and opposite magnetizing forces, the larger change being in the direction of the initial set, there is accordingly a gain in the strength of the magnet in every such case. Ewing in his "Magnetic Induction in Iron and Other Metals," 1892, page 331, refers to this phenomenon.

This point is supported by the experience of Ferranti, who found that the permanent magnets of his type of mercury meter registered too low after a short circuit had occurred. In his meter the axis of the permanent magnets is parallel to that of the series coil.

These conclusions, which are at variance with those reached by Duncan, lead at once to the inference that between the two limiting positions there must be one where complete protection can be found, namely where there is neither demagnetizing nor magnetizing action.

This point it would be well for central-station companies to investigate farther, in order to find at what angle the permanent magnets do receive the most effective protection; for it is apparent that since a meter on which a short-circuit has occurred always favors the consumer, it is quite likely that many cases exist in which the central-station company is supplying energy gratis, while if the protecting angle were once determined for a particular type of meter, the occurrence of short circuits would not be of any particular moment. Lost energy so common to all large central-station systems and often reaching a considerable value, may possibly be partly explained upon the above basis.

The Naval Wireless Telegraph Station at Sitka, Alaska.

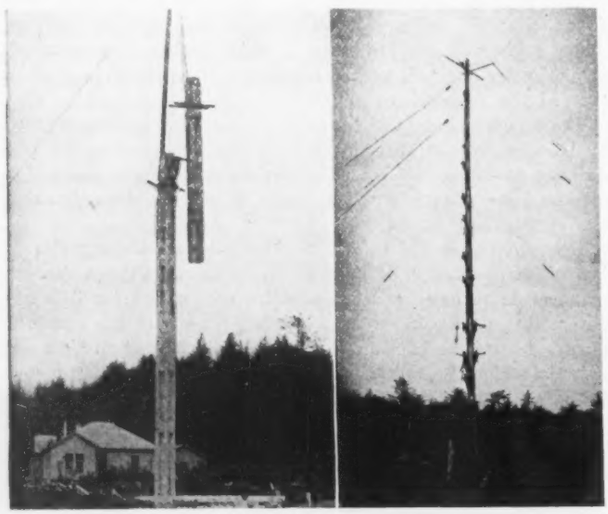
BY H. C. GEARING, U. S. NAVY.

Following the demonstration by Marconi, in 1896, of the practicability of wireless telegraphy the Admiralties of European nations and of the United States were quick to see the adaptability of this new method of transmission of intelligence to marine operations. This included the installation of wireless apparatus on war-ships and the establishment of stations on shore with which the ships might communicate. At the same time other branches of the Federal Government saw possibilities in the new art; the Army, for service in the field and for peace purposes; the Light House Board, under the Department of Commerce and Labor, for bringing its light-ships into touch with the mainland, and the Weather Bureau, under the Department of Agriculture, for use at its isolated stations, such as that at the Farallon Islands, for transmission of its weather reports. Four great departments thus became interested, causing duplication of experiment and promising confusion. To end this President Roosevelt convened representatives of these departments into an interdepartmental board to consider the whole subject.

One of the recommendations of this board, all approved by the President, assigned to the Navy Department the control of all the coast-wise Government wireless telegraph stations, including the island possessions and the canal zone. This naturally includes the coast of Alaska, and, also, such stations as may be installed on outlying light-ships.

Consequent upon this the Bureau of Equipment, under the Navy Department, actively began the installation of the coastal stations, including three, on the east coast, on exposed light-ships, the scheme being to have all these stations dotting the coasts in touch with each other and in communication with Washington by land wire wherever possible. At present there are 30 such stations in operation on the Atlantic Coast, probably

placed nearer together than the latest experience and extension of range show to have been necessary. The stations on the Pacific Coast being installed later than those on the Atlantic, were placed wider apart than on the east coast. The Pacific stations run in geographical order: Pt. Loma, near San Diego; Pt. Arguello; Farallon Islands; Table Bluff, near Eureka; Cape Blanco, Oregon; North Head, mouth of the Columbia River, and Tatoosh Island, off Cape Flattery. In addition to these there are stations at Mare Island and Puget Sound Navy Yards and at Yerba Buena Training Station, San Francisco Harbor; with a station designed for Smith Island, at the



FIGS. 1 AND 2.—MAST IN PROCESS OF ERECTION, AND COMPLETE WITH STRAIN INSULATORS AND AERIAL.

entrance to Puget Sound, but not yet begun. In addition there are stations, one each, at Honolulu, Guam and Cavite in the Philippine Islands; other stations in the Philippines are contemplated.

To extend this chain of coast stations last spring Mare Island Navy Yard was directed to erect stations at Sitka and Valdez, in Alaska, the instruction being modified later to include only the station at Sitka, on account of lack of funds; it is expected that a station will be installed at Valdez next summer. The expedition was to start north by July 1. This gave short time, but happily the contract for the erection of the two masts, buildings, water-tanks, etc., was awarded to the contractor who had so successfully erected all the other stations on the coast. The experience gained in the work was an asset to him and a guarantee to the Government of expeditious work. His party, with all material, sailed from Seattle July 6, and on Aug. 6 his work was completed. A site for the station had been found on Japouski Island, which is separated from the town of Sitka by a narrow strait. This island is under the control of the Navy Department, which has a coaling station already established there.

The next-nearest United States wireless station is at Cape Flattery, 646 miles distant. Immediately inland of the site is high land and on the direct line to Cape Flattery there is high and wooded land. High land, if near by, is obstructive, and wooded land seems to be very absorbent of the waves sent out. These considerations suggested high power for the Sitka station—20 kilowatts, as compared with 15 kilowatts at Tatoosh. Accordingly, specifications for duplicate gas engines driving alternating-current generators, with wireless apparatus filling desired requirements were prepared, and bids were invited for the whole. Hitherto, for other stations, gas engines had been separately provided, built on the Pacific Coast, and only the wireless apparatus was secured in the East. The result of the change of procedure is that engines, generators and wireless are all to be built in the East.

Correctly foreseeing great delay in filling the contract and being loathe to have the summer pass without anything being done, it was determined to provide an improvised installation from what could be found at the Navy Yard. Accordingly a second expedition left Seattle Aug. 4, made up of Navy Yard employees and three wireless operators. The machinery, apparatus and station outfit went with this second party. On Sept. 30 the station was reported as working, and by Oct. 4 the station had had communication with the steamer *President*, distance 650 miles, and had heard North Head Station, distance 767 miles. North Head, for several nights previously had been sending out V-signals, and it may be remarked, incidentally, that it was these signals that the flagship *West Virginia* had heard at 1860 miles, longer than any distance previously achieved in the Pacific. Both expeditions did remarkably well considering their distance from base, the lack of facilities at Sitka, and the almost incessant rain that fell while the work was in progress.

The station has two sectional masts, each 182 ft. high, spaced 400 ft. apart. The masts are made in sections of 26 ft. length for handiness in transportation. Each mast is supported by four sets of guys securely anchored and carefully insulated. The strain insulators are made of chestnut wood boiled in paraffin. The security of this style of mast has been tested by many heavy gales along the coast from Pt. Arguello north.

The operating room, containing the wireless apparatus and dwelling for the three operators combined in one, is midway between the two masts. The style of dwelling, a single-storied bungalow, originated in the East, but has been modified to meet the exposed situations of the Pacific Coast stations, as at Tatoosh, Cape Blanco and North Head, where gales of over 100 miles an hour are not uncommon. The dwelling at Sitka was additionally modified to meet a cold climate, but a closer investigation of climatic records shows that under the influence of the Japan Current, the climate of Sitka is very mild, considering its latitude. It has the same climate as Port Angeles, Wash., or Glasgow, Scotland.

The power house, containing the engine, generator, etc., is near the dwelling to eliminate long electric leads. The oil houses, water-tanks, cistern, etc., are all similar to those at other stations, standardization having been reached. The aerial

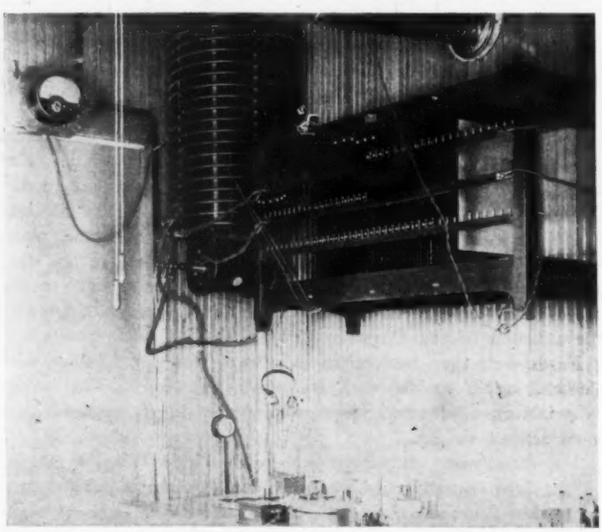


FIG. 3.—OPERATING ROOM AT THE SITKA WIRELESS STATION.

is of four wires, of the form called "flat-top," 370 ft. in length, stretched between the two masts. The result is a natural wave length of 650 meters.

The temporary apparatus is a 25-hp gas engine, driving an alternator generating at 1100 volts and 125 cycles, and a 10-kw Massie wireless set, the induction coil raising the e. m. f. to 40,000 volts. The apparatus eventually to be installed will be duplicate gas engines, silent chain drive, with 20-kw, single-phase, 120-cycle, 500-volt, alternating-current generators. The induction coil will be rated at 20-kw. The set will be capable

of sending any wave length between 300 and 1600 meters, and of receiving any wave length between 200 and 2000 meters. The closed and open circuits, both sending and receiving, will be capable of adjustment to resonance for any wave length within the range of the apparatus, and there will be means for easily and quickly changing the transmitting wave lengths. A contract has been placed with the Massachusetts Wireless Equipment Company, who will supply the Pierce type of apparatus.

The station being on an island, it was necessary to lay a cable across the narrow strait separating it from Baranoff Island, on which Sitka stands. This cable was laid by the Army signal corps and connects the wireless station both by telephone and wire telegraph with the cable office in Sitka. This gives a vessel hundreds of miles at sea in Alaskan waters immediate connection with the various naval stations on the coast and with the seat of government at Washington, and will permit the transmission seaward of the daily noon-time signals sent out from the naval observatory on Mare Island.

There is no doubt that the Navy Department will continue the extension of its line of stations westward from Sitka. The

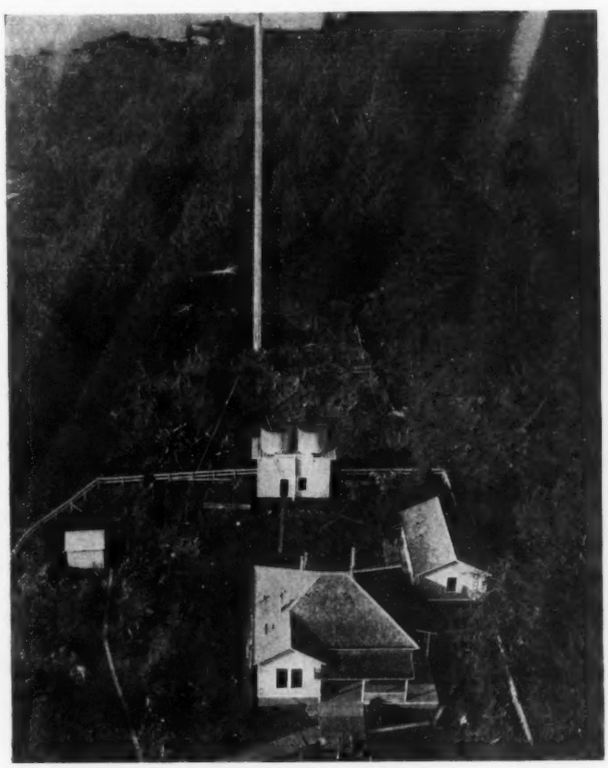


FIG. 4.—STATION AS SEEN FROM THE TOP OF ONE OF THE MASTS.

signal corps of the Army has two stations operating in Alaska, one at St. Michaels and one at Safety Harbor (Nome) working in connection with its Alaska cable system. It was found impossible to keep in order a cable crossing Katzebue Sound on account of the ice. Wireless telegraphy was resorted to with success. According to press reports the signal corps contemplates a number of inland stations to connect points where the difficulties of the country and great cost make land wires prohibitive. The Canadian Government has begun the establishment of stations along the British Columbia and inner Vancouver Island coasts. These are to be located at the following points: Victoria, B. C.; Pt. Grey, B. C.; Pachena Pt., Estavan Pt. and Cape Lazo, and will have a normal range of 100 miles. Cape Lazo, the one farthest north, is 570 miles from Sitka. They are very near each other; none is on the seaward side of Vancouver Island. They have been located, apparently, not for strategic naval purposes, as are ours, but for commercial intercommunication in a thinly settled and difficult region that could hardly support a land-wire service.

Sitka is closely surrounded on nearly all sides by high land. This will militate against any success in communicating with any inland wireless stations that the Army might establish. But this limitation is not very material since the naval strategic purpose of coastal stations is communication with ships at sea, and the range seaward is practically clear. It was feared, too, that the high and heavily wooded land on the line to the southern stations would prove obstructive, but signals from the station have been heard by all the stations from Tatoosh south to the Mare Island Navy Yard. The distance of the latter is 1253 miles. When the more powerful apparatus designed for the station will have replaced that temporarily installed, it is believed that the chain of wireless stations on the coast, from San Diego to Sitka, will be securely established.

Since the above was written the station at Sitka has reported signals from the Army transport *Sherman* at a distance of 2200 miles, which result is the best yet obtained by any of the Pacific stations.

Comparative Performance of Steam and Electric Locomotives.

At the November meeting of the American Institute of Electrical Engineers, Mr. A. H. Armstrong presented a paper outlining some of the fundamental reasons for the substitution of electric for steam locomotives. The author discussed briefly certain steam locomotive improvements, compound versus the simple, and the comparative advantages of different types of electric locomotives. Although the compound locomotive consumes about 20 per cent less steam per hp-hour than does the simple locomotive, yet the latter continues in general use on mountain divisions. The largest steam locomotive yet built is a Mallet compound, which weighs about 300 tons, and gives a sustained output of 2180 horse-power. An electric locomotive of the New York Central type giving the same output would weigh only 100 tons. On account of the limited output from a steam locomotive, it may be stated that for a certain gross annual ton-mileage, the cost of steam locomotives may be even greater than the cost of the electric units replacing them.

As against the reduction in fuel expenses promised by the use of compound locomotives fitted with superheaters and feedwater heaters, the electrical equipment provides the possibility of regeneration of energy while electrically braking on mountain-grade divisions. The chief advantage of regeneration lies in the assurance it offers of greater safety in operating on heavy grades. The present method of braking, by friction between wheel and shoe, results in overheated parts, breakages resulting therefrom and consequent danger of derailment. The descent of a long, heavy mountain grade is accompanied by the shoes and wheel rims becoming heated to a dull red, while the introduction of the electric locomotive offers an opportunity of holding the train in whole or in part by means of the same motors used to haul it up grade, and thus eliminating one of the greatest sources of danger in mountain railroading.

As to the relative costs of using electric and steam locomotives, the author showed that for operation up and down grade, with simple locomotives and without electric energy regeneration, the operating expenses per ton-mile would be from about 23 per cent to 36 per cent greater with steam than with electric locomotives.

The writer stated his belief that the time is not ripe for the substitution of electricity for steam on all roads. There are, however, certain divisions of steam railroads which, either on account of their broken profile or heavy traffic, offer an opportunity to introduce a superior type of locomotive which will effect economies in operation sufficient to provide adequate return on the investment required for the substitution. There are still other divisions where a much desired increase in the track-tonnage can be effected only by double tracking so long as the steam locomotive is adhered to. Double tracking a mountain-grade division is often a matter of enormous expense, and the use of electric locomotives on the single track may relieve the present traffic congestion at a moderate cost.

On mountain-grade divisions the subject of regeneration with electric locomotives should receive very careful consideration, not so much on account of the saving in energy which it may effect, but rather on account of the greater safety of operation which it guarantees by eliminating the serious defects of holding trains on heavy grades by wheel and shoe friction. Finally, there are the many incidental advantages to be gained which cannot be predicted with any accuracy, as they result from changes in operating methods sure to follow the introduction of a type of locomotive not subject to the service limitations of the steam locomotive.

The freight-car shortage problem itself is a very serious one at certain times of the year on some roads, and as the total freight-car mileage can be increased with the higher speeds provided with electric locomotives, it should result in the saving of a considerable expense now incurred for rental of foreign cars, or even increase the gross receipts by the movement of tonnage which a larger number of available cars would make possible.

New Telephone Patents.

SWITCHBOARD CIRCUITS.

As a means for reducing the responsibility and labor of the telephone operator, automatic ringing has been long since suggested. With such an arrangement the period of ringing begins automatically at the instant of plugging in and without any special act of the operator. It then continues either steadily or intermittently until the response of the called party. Mr. W. W. Dean has patented such an arrangement, adapted to the Dunbar two-wire system. The ringing is controlled by a double-wound self-locking relay, through one winding of which the ringing current is led. The relay will not respond to the current as long as the bell is in circuit, but it does respond as the transmitter shunts the bell. Mr. Dean has assigned his patent to the Kellogg Company.

H. G. Webster, of Chicago, has also obtained a circuit system patent, assigned to the Kellogg Company. His invention relates to the arrangement of line relays in a two-wire system. Two relays are provided which must co-operate to effect a signal. When a plug is in the line jack, however, one of these relays becomes shunted out by a low resistance supervisory relay in the cord circuit.

AUTOMATIC SYSTEM.

With automatic systems there must always be provided some means to prevent a third party from switching himself onto a busy line, and thereby interfering with the conversation. Mr. F. A. Lindquist, of Chicago, has obtained a patent for a system in which a special circuit and relay takes care of this. The relay fails to operate except when connected to a busy line. Under this latter condition it does operate to sever the talking connection between the interloper and the existing connection.

Letters to the Editors.

Long-Distance Wireless Telegraphy.

To the Editors of Electrical World:

Sirs:—The observations of Mr. Ernest F. Smith, in your issue of Nov. 9, regarding the maximum electromagnetic effort at a point antipodal to the source of the waves are interesting. The same idea has been advanced previously, I believe, by Mr. Tesla.

Mr. Smith, however, fails to take into consideration the "losses" which these waves continually suffer as they travel from their source. It would be a powerful station, indeed, which could be heard on the opposite side of the earth, and it seems rather a waste of time to speculate as to the physical explanation of an alleged wireless message anent the arrival in Philippine waters of a ship which has been lying out of commission at Seattle for three years. I should opine that the real explanation of this phenomenon lies more properly in the realm of psychology.

Not only should the location of Port Morien, approximately 180 deg. from Manila, be considered, but also the time of receipt of this message, a time properly defined as the psychological moment.

New York. Lee de Forest.

Turbine Tests.

To the Editors of Electrical World:

Sirs:—I would like to correct an error in a statement made under the head of "New York Turbo-Generators" appearing in your Nov. 2 issue, in which, referring to the Sept. 1 test of one of the Westinghouse-Parsons 7500-kw turbines which showed a water rate of 14.9 lbs. per kilowatt, it is stated: "It is said to have developed results hitherto unattained by any steam prime mover in this country."

The above is undoubtedly a correct quotation of the statement, but the statement is not borne out by facts. One of the 5000-kw Curtis steam turbines in operation in the station of the Boston Edison Electric Illuminating Company, as tested by the Edison Company's engineers, developed a water rate of 13.5 lbs. per kw-hour; and an 8000-kw Curtis turbine in operation in the station of the Commonwealth Electric Company, of Chicago, as tested by its engineers, developed a water rate of 12.5 lbs. per kw-hour, or a water rate over 16 per cent better than the one to which the statement referred. This last-mentioned result, namely, 12.5 lbs. of water per kw-hour, is, I believe, the best water rate which has ever been developed by any steam prime mover of any form, either in this country or abroad.

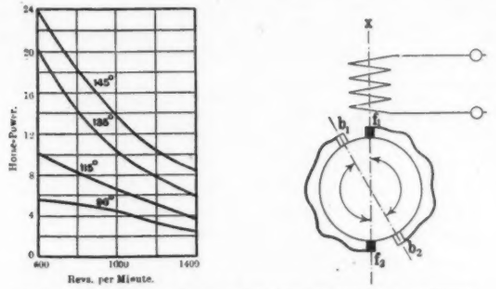
Boston, Mass. Chas. B. Burleigh.

DIGEST OF CURRENT ELECTRICAL LITERATURE.

Dynamos, Motors and Transformers.

Single-phase Repulsion Motor.—An illustrated description of the construction and method of operation of the Deri single-phase commutator motor developed by Brown-Boveri Company which has already been noticed briefly in the Digest. The motor is a pure repulsion motor and its principle is shown in Fig. 1. The stator winding alone is connected to the external circuit. The rotor winding has no external connections whatsoever, either directly or through transformers. The brushes bearing on the commutator are short-circuited amongst themselves. The essential novelty in the Deri motor which distinguishes it from the ordinary repulsion motor relates to the arrangement of these brushes. There are two sets of brushes of which the pair f_1f_2 is stationary while the pair b_1b_2 is movable. The angular movement of these latter two brushes represents the method of regulation. Vector diagrams are given to explain the principle. Fig. 2 gives the curves between the speed and output of a 6-pole, 10-hp, 50-cycle motor. The four curves relate to four different positions of the set of brushes b_1b_2, namely when the angle between b_1b_2 and f_1f_2 is 96°, 115°, 135° and 145° respectively. The trend of the curves shows the series character of the motor. So far it has been assumed that there is no connection between the two sets of brushes. By arranging, however, to connect these with one another through an adjustable resistance, as shown in Fig. 3, the curve of torque and speed, which without this connection would have the form of the curve designated $W = \infty$ in the right-hand diagram, may, by adjustment of this resistance, be so modified as to

become W_1, W_2, W_3 and W_4. In the operation of cranes, a frequent requirement is that when lowering the load an automatic braking action shall be exerted. One way of attaining this with the motor described is as follows: The movable brushes are separated from the fixed brushes and are connected with one another, and the stator winding is connected to the



FIGS. 1 AND 2.—SINGLE-PHASE REPULSION MOTOR.

supply circuit as shown in the left-hand diagram of Fig. 4. In the brush position and for the direction of rotation there shown, the motor acting as an ordinary repulsion motor, exerts a strong torque in opposition to the direction of rotation. This torque may be regulated either by adjusting a resistance interpolated between the brushes, or by moving the brushes in a direction opposite to the direction of rotation of the rotor. When the movable brushes, moved in opposition to the direction of rotation, approach an angle of 90° behind the fixed brushes,

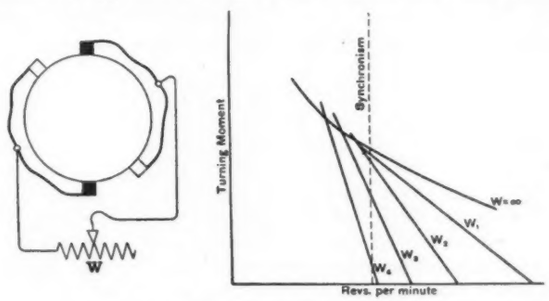


FIG. 3.—SINGLE-PHASE REPULSION MOTOR.

the braking action becomes exceedingly weak (middle diagram of Fig. 4), and by opening the connection between the brushes it will be reduced to zero. If it is then, as so frequently happens, necessary to give to the load which is being lowered a further additional positive movement, the brushes may be again connected in the normal manner as shown in the right-hand diagram of Fig. 4. As actually developed for industrial use, the stator of the motor has an appearance closely resembling that of the ordinary induction motor while the rotor

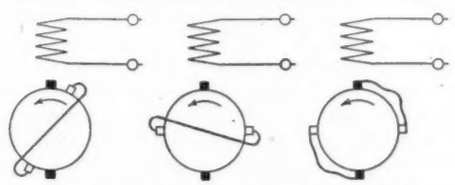


FIG. 4.—DIAGRAM OF POSITIONS OF BRUSHES.

is generally built just like an ordinary direct-current armature. It seems that the motor is used chiefly for small ratings, or from 2 to 10 horse-power, but it is stated that a traction motor for 40 horse-power at 80 volts and 33 cycles and with a rated speed of some 500 r. p. m. has also been developed.—Lond. *Elec. Eng'ing*, Oct. 24.

Glass Brushes for Cleaning Commutators.—A note stating that a European Company has placed on the market brushes made of glass, which are to replace emery cloth for cleaning and polishing the commutators of dynamos and motors. These brushes are said to clean the commutators without scoring the metal, and their use avoids the inconveniences and dangers of emery cloth.—Lond. *Electrician*, Oct. 25.

Lamps and Lighting.

Electric Arc Between Metallic Electrodes.—W. G. CADY and H. D. ARNOLD.—Up to the present, most investigations on the electric discharge between metals have been confined either to the glow discharge chiefly at low gas pressures, or to the arc discharge at relatively high current densities, where a pronounced volatilization of both electrodes takes place. The present authors have studied systematically the transition from one form of discharge to the other, paying particular attention to the phenomena with small currents. The chief results are as follows: There exist between iron terminals in free air two types of arc, distinct from each other in appearance and in characteristic curves. To these types the terms first stage and second stage are applied for the sake of brevity. The transition from one stage to the other is somewhat similar to the hissing point of the carbon arc, but the cause is not the same. Evidence from loss in mass of the electrodes, spectrum of the arc, and temperature of the anode, shows that the first stage is characterized by the absence of vaporization of the positive terminal. Experiments are described on the change from the glow discharge to the arc in free air between terminals of iron, platinum and copper. Attempts were made at identifying the two stages for arcs between several different metals in air. Both stages could be maintained steadily only in the cases of copper and of iron. In nitrogen at reduced pressures the glow and both stages of the arc were observed between a carbon cathode and anodes of lead, silver and carbon. There is reason to believe that similar results can be obtained with most other metals. Platinum, and iron free from traces of oxide, did not show a stable first stage under any conditions. The diminution in potential difference between the arc terminals in passing through the critical point from the first to the second stage is attributed partly to a decrease in the thermal e. m. f. at the anode, partly to increased conductivity of the arc vapor. There is some evidence of a connection between the critical point and the melting temperature of the material of the anode, but it is not well marked, and is likely to be masked by effects due to the physical condition of the surface of the anode. The characteristic curves of the iron arc are discussed, together with the probable form of the equation connecting voltage, current and length. A series of experiments was carried out on electrical oscillations in arcs with iron, copper, and silver anodes. At a current a little below two amperes, on the second stage, the iron arc rotates and emits a whistling sound. This is often attended by spasmodic changes back to the first stage. The application of Lecher's test for continuity led to observations on the "singing" iron and copper arcs, the energy expended in the oscillations in both stages of the arc being observed by means of a bolometer. To test the continuity of arcs between various metals by a method more free from error, a new manner of connecting the bolometer was devised. A general agreement with Lecher's results for large currents was found. But the iron arc became continuous on the first stage, while in the case of arcs with silver or copper anodes, marked oscillations were detected as the current decreased.—*American Jour. of Science*, November.

Comparative Cost of Gas and Electric Lighting.—E. G. KENNARD.—A comparison of the cost of lighting by gas or electricity. Three groups of sources of light are distinguished, representing weak, medium and strong sources. In the first group there are sources of between 40 and 60 candle-power, and the author finds that for the cost of 2.36 cents per cubic meter of gas and 8.4 cents per kw-hour, the cost of lighting by the osram lamp is twice that of gas lighting with an incandescent mantle, while the cost of the tungsten lamp is about 50 per cent higher than that of the gas mantle. For lower sources of light, such as 10 candle-power, the situation becomes more favorable to electric light. In the second group, which comprises sources of light between 200 and 400 candle-power, he finds that under the same conditions of cost of gas and electrical energy as given above, the electric flame arc and the Cooper-Hewitt lamp are cheaper than the "gas arc," but the latter is cheaper than the enclosed electric arc. In the third

group, which comprises sources of light of 600 candle-power and more, he compares the Blondel arc with gas lamps of 670 candle-power in favor of electric lighting. The ideal electric system for lighting would be the direct-current system at 60 volts, since arc lamps could be operated at this e. m. f. without waste of energy and metallic-filament lamps could also be used at this voltage. Direct-current lamps at 60 volts are hardly available. Alternating current is in all cases preferable to direct current at 100 volts for private lighting since it is possible to obtain any desired e. m. f. by the simple use of a transformer.—*L'Eclairage Electrique*, Sept. 14, 21.

Tungsten Lamp.—A note on a British patent of the British Thomson-Houston Company. Metallic tungsten for the manufacture of lamp filaments is prepared in the form of rods by the usual processes. These rods are then drawn while in a heated condition by means of die plates. The heating is produced electrically, and to prevent oxidation of the tungsten during treatment it is electroplated with silver, copper or gold. The protecting metal coating is finally removed by heating in a vacuum.—Lond. *Elec. Eng'ing*, Oct. 24.

Flame Arc Lamp.—H. E. Angold.—A description of an arrangement for flame arc lamps with converging electrodes feeding through tubes, whereby, when the feed mechanism reaches a certain critical point, a contact is closed which short-circuits the lamp through a suitable resistance and so causes a very definite feed to take place.—Lond. *Elec. Eng'ing*, Oct. 24.

Power.

Combined Gas-engine and Steam-turbine Plant.—L. Andrews.—Some data on the comparative first cost and cost of operation of steam-turbine and gas-engine plants. The first data given refer to a 16,000-kw plant working at unity power factor. The capital cost per kilowatt installed is given as $65.50 for steam turbines and $94.40 for gas engines. On the other hand the total cost per kw-hour (including interest and depreciation at 10 per cent) is 0.408 cent for the steam-turbine plant and 0.270 cent for the gas-engine plant. With decreasing load factor the advantage of the gas-engine plant over the steam-turbine plant becomes less and less and from the values given by the author for a 15-per cent load factor it appears that for a 16,000-kw plant the total cost per kw-hour is 1.090 cents for the steam-turbine plant and 1.132 for the gas-engine plant. With such a low load factor there would be no advantage in putting down a gas-engine installation. The dominating item of the running charges on a low load factor is the item of interest and depreciation, whereas on a high load factor the dominating charge is the cost of fuel. The two curves in Fig. 5 show the total running costs per kw-hour, as depending on the load factor when the latter varies from 10 to 100 per cent; a 16,000-kw plant being assumed and 10 per cent being charged for interest and depreciation. The author recommends installing

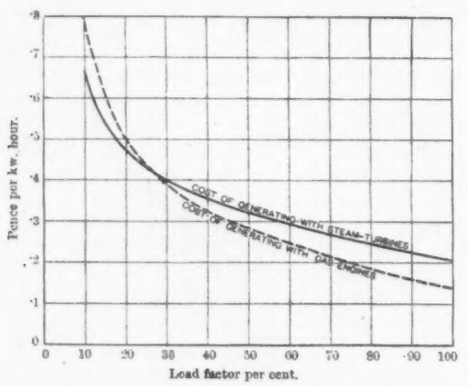


FIG. 5.—CURVES OF COSTS OF GENERATING.

a combined gas-engine and steam-turbine plant to suit the load diagram in Fig. 6 which relates to a total plant equipment of 16,000 kilowatts and a maximum demand of 13,000 kilowatts. It is suggested that 25 per cent of the total plant should be gas engines and the remaining 75 per cent steam turbines. The average load on the gas-driven generators will then correspond to a 62-per cent load factor, whereas the steam-turbine plant will be running on a load factor of 7.5 per cent. The combined average load factor is 25 per cent of the maximum demand or 19.5 per cent of the plant installed. It is estimated that the running cost, including interest and depreciation, would be 0.82 cent per kw-hour. If only gas engines or only

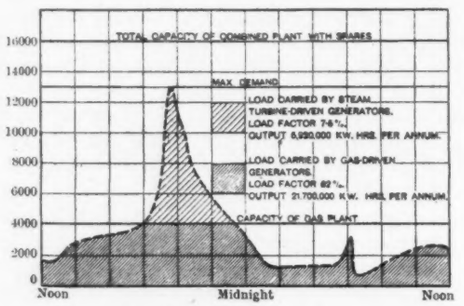


FIG. 6.—LOAD DIAGRAM.

steam turbines would be used the cost would be higher.—Lond. *Elec. Eng'ing*, Oct. 24.

Electricity in Mines.—H. R. Speyer.—The conclusion of the illustrated article on the electric equipment of the Mansfeld copper mines. Particulars are given of a sub-station which is supplied with energy both from a gas-engine station at 3000 volts and from a new 10,000-volt steam station. Descriptions are given of the electric pumping plant at one mine and of the very complete equipment at another mine, including examples of electric underground haulage, ventilation, pumping, etc.—Lond. *Elec. Eng'ing*, Oct. 24.

Electric Energy for Farming.—E. W. Lehmann-Richter.—An illustrated description of the use of electric motors and lamps on farms, with special reference to an installation on a farm on the island of Ruegen, in Germany. A gas-driven 20-kw direct-current shunt generator is employed there in connection with a storage battery of 270 ampere-hours when discharged in three hours. Electric motors are used for thrashing, for driving various cutting machines, pulverizing mills, cream separators, etc.—*Elek. Zeit.*, Oct. 24.

Electric Cranes.—H. H. Broughton.—A continuation of his illustrated serial in which the author deals with the general arrangement and speed of electric cranes and then considers the electrical equipment in detail. The series-wound, continuous-current motor is naturally preferred, though the single-phase commutator motor is now available for alternating-current working. Three-phase motors are unsuitable for crane working.—Lond. *Electrician*, Oct. 25.

Ignition of Gas Engines.—J. G. Charvet.—A note on the Lodge method of ignition for gas engines.—*L'Eclairage Electrique*, Sept. 28.

Traction.

2000-volt Direct-current Railway.—A full illustrated description of a small railway in Germany, connecting an iron mine with a blast furnace and being operated at a direct e. m. f. of 2000 volts, as has already been briefly noticed in the Digest. This narrow-gage (one meter) railway is 8.7 miles long and carries at present about 2600 tons of ore per day, two trains being required, which pass one another at a turn-off about in the middle of the line. Each return journey takes about 2 hours. The weight of a train ranges from 200 to 300 tons, and there are gradients ranging up to 3 per cent. The loads were too severe for steam locomotives, and in order to enable 4000 tons to be dealt with per day, the steam locomotives had to be replaced by electric locomotives. Three-phase traction was unsuitable on account of the number of trolley wires required, and the choice was therefore between the high-voltage, direct-current and the single-phase system. Estimates were made for both systems, the direct e. m. f. being assumed to be 2000 volts and the single-phase e. m. f. 6000 volts, the rails being used as return in each case. The high-tension, continuous-current motors have short commutators and a proportion-

ately large effective core length, while the single-phase motors, designed for a low pressure, have long commutators and consequently a shorter effective core length. A continuous-current motor of 160 horse-power could be built within the space allowed by the narrow gage, but 60 horse-power was the maximum output of a single-phase motor under the same conditions. It must be remarked, however, that the diameter of the armature was not limited by the height of the floor of the locomotive or the diameter of the wheels, and that this circumstance was only taken advantage of in the case of the continuous-current motor. Four continuous-current motors were found to be sufficient for the power required, while six or more single-phase motors would have had to be provided. Comparing the two systems with regard to the current distribution, the single-phase system with its high line voltage was superior to the continuous current system, notwithstanding the greater losses in the return circuit and the inductive losses. A disadvantage of the single-phase system, which had to be considered, was that the stray currents might seriously effect signal and telephone circuits, even at considerable distances from the line. It was found, however, that the railway could be economically worked with continuous current at 2000 volts without using an excessive amount of copper, and this fact, together with the superiority of the continuous-current motors, decided the issue. Had the line been of much greater length the single-phase system would have shown to greater advantage. The direct e. m. f. of 2000 volts is obtained from two motor-generators. Each of the four axles of the locomotive is driven through gearing by a 160-hp motor. The motors are permanently connected in two groups of two in series. The motor-armatures have 61 slots, each of which has 12 coils of flat copper. The commutator is large in diameter and is built with 83 segments. There are two sets of three brushes. In order to ensure sparkless running, the motors are provided with commutating poles. This is a matter of great importance in high-tension motors, where very little sparking may cause flashing over or start an arc to the earthed frame. As a further safeguard all the space round the commutator is lined with insulating material.—Lond. *Elec. Eng'ing,* Oct. 24.

Electric Traction in Switzerland.—The report presented by Prof. Wyssling, on the work which has been done by committee for studying electric traction in Switzerland. The sub-committee has finished the investigation of 22 typical electrical systems. While it is too early to give the complete results, some general points are already evident. The recuperation of energy on grades is found to be practically too difficult, and not sufficiently economical to be taken into consideration. With respect to the variations of load, the different systems of storing energy have been considered and the conclusion has been reached that hydraulic storage is not as economical as it is often thought to be. As to the question of the supply of electric energy to trains, the third-rail seems to find the greatest sympathies with railway engineers. Its disadvantages are the high first cost and the fact that it is impossible to go beyond a certain e. m. f. At the safety limits of e. m. f. the following values are given for different systems: direct current with third-rail, 800 volts; direct current with overhead wire, 3000 volts; three-phase system, 5000 volts; single-phase system, 15,000 volts; "with a direct e. m. f. of 3000 volts is meant that 1500 volts are safe per commutator of a motor." As to the disturbances which are caused by electric railways on telephone and telegraph lines much has been learned from the line from Seebach to Wettingen, where the endeavor to avoid all such disturbances has been finally successful. The committee has not yet agreed on a single system of traction as universally suitable. Among the many details which have been investigated, is the ratio of weight to output. This will be somewhat unfavorable to the single-phase system, but it has yet to be determined how far this will be the case. On the Swiss railways the starting torque is 2½ times the normal torque. This ratio can be obtained with single-phase motors, but the question of weight must also be taken into consideration. The members of the committee cannot agree on a certain frequency, although the latter will be between 15 and 25. Some want 25 because this has been taken over from the United States; others want a lower frequency. The cost is of great importance and it has been decided to make exact calculations for 25 and 15 cycles per second. Very complete calculations of the cost of electric operation on the St. Gotthard railway and on a certain net-work of railways will be made, first for the present traffic and second for a hypothetical increased traffic. The committee hopes to conclude its investigations during the next year.—*Elek. Zeit.,* Oct. 24.

Electrical Equipment of Prussion State Railways.—A summary of an estimate of Pforr of the cost of converting the Prussian State Railways from steam to single-phase traction. Costs of Erection: The energy would be transmitted at 50,000 volts to sub-stations placed 25 miles apart along the line. It would there be decreased to the trolley e. m. f. of 15,000 volts. Each sub-station would have an output of 5000 kilowatts on double lines, or 3000 kilowatts on single lines. It is estimated that these stations would cost $25,000,000 for the total 12,860 miles of double track and 8275 miles of single track. Line equipment would cost $4,000 a mile, while from $1,600 to $2,600 would be expended on the feeders. The total cost of the feeding and distributing system would be $235,000,000. Locomotives: Only 64 per cent of the present number of steam locomotives would be required. A 600-hp electric locomotive weighs 42 tons, while a steam locomotive weighs 57 tons unloaded. The cost of the electric locomotives may be taken as $133,750,000, as against $167,000,000 for the steam locomotives. Generating stations: These would also supply energy to the surrounding districts, otherwise the load factor would only be 20 per cent, and reckoning the cost of the station at $87.50 per kilowatt, the interest, etc., would work out at 0.4 cent per unit. But by connecting up private consumers it is hoped this may be decreased to 0.32 cent per unit. Fuel would cost 0.2 cent and attendance, etc., 0.1 cent, or a total of 0.7 cent per unit. Working costs: The working expenses by steam for the year 1904 amounted to $241,800,000, but it is hoped that a great saving would be effected by the adoption of electric traction. The decrease in wages is estimated at $10,750,000, and in cleaning at $1,000,000. The up-keep expenses with electrical working would show a decrease of $45,000,000, from which $4,250,000 must be taken for line upkeep.—Lond. *Electrician,* Oct. 25.

British Tramway Plant.—An account of the last annual report of the municipal tramways of Wolverhampton. This system is of special interest since it is the only place in the United Kingdom where the Lorain surface-contact system of electric traction is used. "The undertaking still feels the bad results of the first few years of working, but it is satisfactory to note that the corner seems to have been turned—it is to be hoped, permanently." The total expenses, including capital charges, were 20,722 cents per car-mile, while the corresponding income from all sources was 22.074 cents.—Lond. *Electrician,* Oct. 25.

Railway Signals.—The first part of a fully illustrated description of the electric signal installations at the Euston & Crewe stations of the London & Northwestern Railway. At each station the Webb-Thompson system of signalling and point operation is in use. Electric power directly applied is employed, by means of motors in the case of points and solenoids in the case of signals, so that the operating parts are of the simplest possible character.—Lond. *Electrician,* Oct. 25.

Railway Signals.—W. E. FOSTER.—In a continuation of the long illustrated serial on railway signalling, the "language of fixed signals" is explained.—*Electric Journal,* November

Installations, Systems and Appliances.

Combined Gas and Electricity Works.—An illustrated description of the new station at Ascot. This is the only instance in Great Britain of an electricity supply station running in connection with a gas works. It is the only case in which a gas company succeeded in obtaining parliamentary power to supply electricity and at the same time secured the rejection of a competing application. The electric generating station has been erected in close proximity to the gas works. Electric motors are being installed in the gas works for a number of purposes. The electric generating plant consists at present of

two gas engines, each capable of working continuously at 90 horse-power, and coupled to a direct-current generator capable of giving normally 110 amperes at 460 volts, with a speed of 210 r. p. m. Gas is supplied from a suction producer, the fuel being coke from the gas works. Only a very small space is taken up by the producer plant and the convenience of a stand-by gas supply is evident. The price of energy has been fixed for the present at 14 cents per kw-hour for lamps and 8 cents per kw-hour for motors, the e. m. f. of supply being 220 volts on either side of the three-wire system. The price of gas is $1.12 per 1000 cu. ft.—Lond. *Electrician,* Oct. 25.

Choice of System for Cities of Medium Size.—F. Ross.—The author refers to an article by Niethammer in an Austrian daily paper in which the direct-current system is considered to be the most suitable one for cities of less than 100,000 inhabitants. Reference is made to the city of Goerlitz, in Germany, which is a city of 85,000 inhabitants, and in which in the year 1895 a 2000-volt, single-phase plant was installed, but was later changed to a direct-current, three-wire system at 2 x 220 volts to make the operation more economical. The present author denies that the economy of this plant has been improved at all by this change. He thinks that in erecting new plants it is now important to think of the installation of low-voltage, high-efficiency metallic-filament lamps. For this purpose the alternating-current system appears to be preferable.—*Elek. u. Masch.,* Oct. 13.

Effect of Sea Water on Pipes on Board Ships.—M. Lussac.—An account of the effects of stray currents on the condenser pipes on board ship. The pipes referred to are of copper, and are connected together by galvanized elbows and bronze collars, and are supported on hangers fixed to the bulkheads. It has been noticed that the most corroded parts are those where the metal has been worked, and in these places the metal is deeply pitted. The stray current seems to increase with the circulation of the water. This effect cannot be explained by the acidity of the lubricating oil, as pipes into which the oil never penetrates are affected in the same way. As the usual e. m. f. on board ship is 80 volts, while the insulation resistance is about 16,000 ohms, it may be supposed that there are stray currents whose total intensity is 0.005 ampere flowing in the hull of the ship. As the hull is made up of riveted places whose joints are oxidized, it is not very conducting, and the path of the stray currents is generally through the copper pipes which are connected to it. When the path reaches a more or less insulating joint, it passes into the liquid and a sea-water voltameter is thus formed. One pipe forms the anode and is eaten away, while the same effect will be noticed on the other pipe if the current is reversed. The effect is best prevented by bonding the joints across, and thus providing a low-resistance path for the current. It has been found that this action is not confined to pipes carrying sea water, but that it also appears on fresh water systems, and increases with a rise in voltage.—Lond. *Electrician,* Oct. 25.

Power-Factor Improvement.—C. I. Young.—The author refers to a former article of W. Nesbit on synchronous motors for improving the power-factor in which a method was described for determining the characteristics of a synchronous motor required to raise the power-factor of a given kv-amp load from its original value to a higher value. The author has worked out a "graphic calculator," that is, a chart by which it is possible to find the power-factor improvement. The method of using this chart is described.—*Electric Journal,* November.

Electrophysics and Magnetism.

Theory of Wireless Telegraphy.—J. Zenneck.—A mathematical discussion of the propagation of plane electromagnetic waves over plane surfaces and of the absorption of such waves by the atmosphere. Marconi has shown that the distance one can reach by wireless telegraphy is two and one-half times as great by night as by day, and he attributes this phenomenon to the increased absorption of the waves due to ionization of the air by daylight. Zenneck's calculation shows that the layers of air less than 6000 meters from the earth's surface cannot change their conductivity by daylight sufficiently to account for the absorption of the waves, and he believes that this absorption is due to the loss of energy from the antennæ due to daylight. It is probable also that the good effect of clouds and fog is due to the protection of the antennæ from this loss of energy due to light. The waves employed in wireless telegraphy in passing from water to land and in the reverse direction must suffer partial deflection. The amplitude, therefore, of the wave depends not only upon the distance the waves have traversed over sea and land, but also upon the shore form, or barrier between land and sea. On this partial reflection depends the fact that less distorted waves are received at a distance from the sender than at a station near the sender.—*Ann. d. Physik.,* No. 10, p. 846; abstracted in *Am. Journal of Science,* November.

Pinch Phenomenon.—P. Bary.—Some notes on the "pinch phenomenon" and on Northrup's paper on this subject.—*L'Eclairage Electrique,* Sept. 28.

Units, Measurements and Instruments.

Resistor Coils and Comparisons.—C. B. Drysdale.—The conclusion of his long serial in which the author gives the general theory of the slide-wire bridge, and then describes in detail a slide-wire bridge for standardizing devised by him, and in which he has combined in a single bridge the possibility of testing, either by the Reichsanstalt or Cary-Foster methods, coils of high or low resistance and of any gauge.—Lond. *Electrician,* Oct. 25.

Telegraphy, Telephony and Signals.

Generator for Spark Telegraphy.—P. Villard.—The sparks used in wireless telegraphy are usually produced either by an induction coil or by an alternating-current transformer. The former equipment is of very limited power output, and the second has the inconvenience of giving too many sparks and thus wasting energy. A method for reducing the sparks in number from, say, 80 or 100 per second to 10 or less per ceond, has recently been described by Blondel. It consists in having the secondary circuit of the transformer slightly out of resonance with the alternating current, so that beats are produced; and thus the sparks may be reduced in number till there is, say, only one every ten alternations. In this method the regulation must be very precise. A simple method consists in the use of a special alternator. The armature is fixed and carries two bobbins, and the field magnet rotates inside it. This field-magnet is shaped somewhat like the letter H, and presents four poles of alternate sign arranged in two close pairs, one pair diametrically opposite the other. During nearly a half turn these poles do not pass in front of either bobbin and the losses reduce to those in the sheet iron of the stator. All the driving power is spent in a small fraction of a turn. First one pole passes before a bobbin and produces therein an e. m. f. of, say, $+E$, then a second pole, replacing the first, produces an e. m. f. of $-2E$, and finally this latter pole in leaving the coil induces $+E$. Thus each period is composed of three alternations, of which one is double either of the others. By aid of a transformer it is easy to arrange that each period gives one spark, and each spark is always in the same sense.—From *Comptes Rendue;* abstracted in Lond. *Elec.,* Oct. 11.

BOOK REVIEW.

Electrical Installations of the U. S. Navy. By Commander Burns T. Walling, U. S. N., and Julius Martin, E. E. Annapolis, Md.: U. S. Naval Institute. 648 pages, 300 illustrations. Price, $6.00.

In the absence of a preface, it may be assumed that the object of this voluminous compilation is to furnish a manual for the instruction of those persons in the Navy who have to do with the installation and operation of electrical plants aboard war ships, or are charged with the purchase and inspection of naval electrical material. As such, the volume should prove extremely useful to the naval service, and also of no little

value to those outside having a practical interest in the application of electricity to marine purposes. Moreover, much information of general value is scattered throughout the pages relating to the construction, operation and care of apparatus, operation of storage batteries, inspection and testing of material, etc. It is true that war-ship conditions demand a maximum of reliability entirely regardless of the expense involved, thus conflicting with commercial principles, which include the factor of cost in the formula of maximum economy. Nevertheless, the requirements for naval apparatus and material have an interest in that they presumably represent the highest standards that have been attained. To students the descriptions of apparatus and appliances should prove useful, as in general they are in fuller detail than can be found outside of manufacturers' catalogues, and do not assume on the part of the reader any special knowledge of electrical engineering. While the book does not possess the character of a connected treatise, but appears rather to be mainly a compilation from naval technical files, manufacturing companies' bulletins and note-books of the authors, yet from it an excellent idea may be obtained of the remarkable extent to which in recent years electricity has found application on shipboard, and particularly on war vessels.

The book opens with a chapter on incandescent lamps, from which we learn that in the navy, aside from 16 and 32-cp lamps for general purposes, special lamps are used as follows: 1, 2 and 5-cp for instruments; 6-cp for torpedoes; 10-cp for signaling, and 150-cp for diving purposes. The standard voltage in the navy is now 125, but some of the older vessels employ 80 volts—the former standard voltage—while the vessels purchased during the late war have 110-volt plants. The greater part of the chapter is devoted to a description of the method of inspecting and testing incandescent lamps in use at the New York Navy Yard. Chapter II has for its subjects arc lamps and search lanterns, the types used in the navy being described in detail and instructions included for their operation. Standard wire is the subject of Chapter III, which includes the specifications and tests of the various types of conductors used in the navy. The next chapter, entitled "Wiring Appliances," deals with circuit installation and fittings. Chapters V and VI describe in detail the naval types of generating sets, the greater amount of space being devoted to the steam end. Three chapters have for their subject motors, in which their numerous applications on shipboard are detailed. Chapter X is devoted entirely to instructions for the preliminary inspection, preliminary test and final test of generating sets and motors. Chapter XI is on auxiliary apparatus and instruments used in generating sets and motors, such as measuring instruments, circuit breakers, etc. Chapter XII consists of practical notes on the operation and care of generating sets and motors. Chapter XIII has for its subject electric fixtures and lanterns of the special types employed on war ships; and the following chapter is devoted to the electrical devices used for interior and exterior communication, including night signaling. In view of the general use in the navy of wireless telegraphy, it is somewhat surprising to find that this subject receives no mention in the book. The final and longest chapter is entitled "Notes on Installation," and consists of practical instructions on the laying out of war-ship electrical plants and their installation.

Sturtevant Steam Turbine.

Recent performances have demonstrated that the reciprocating engine has a strong rival in the modern steam turbine. Although the relative steam economy of the turbine and the reciprocating engine is still a question, it must be remembered that the piston engine has been developed uninterruptedly for nearly two centuries, and when the same activity of research and design has been directed to the steam turbine, its economy will doubtless equal, if not surpass, the older form of prime mover. Assuming that there is not an appreciable difference in economy as regards cost of fuel, such advantages as simplicity, durability, freedom from oil in the exhaust steam, absence of valve adjustments, etc., must find favor in many installations.

Several years ago it became apparent to the B. F. Sturtevant Company that the steam turbine was particularly adapted for direct-connection to their blowers and small generators. The experimental work was conducted by Mr. William E.

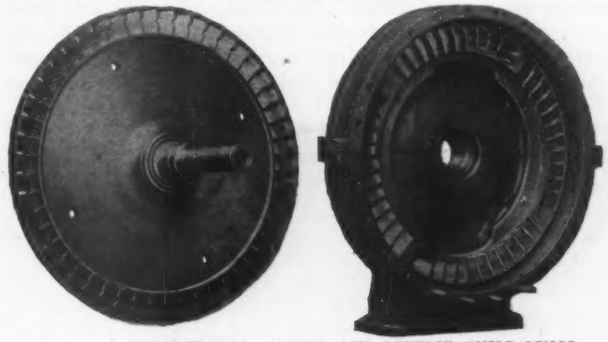


FIG. 1.—BUCKET-WHEEL, CASING AND REVERSE GUIDE RINGS.

Snow, of the engineering staff, and the turbine is now built under his patents. The resulting machine, which is a modification of the Riedler-Stumpf type, admirably fulfills the requirements of this work. Steam enters at the sides of the bucket wheel through nozzles of Tobin bronze and acts upon the buckets cut in the wheel. Similar buckets in the steel station-

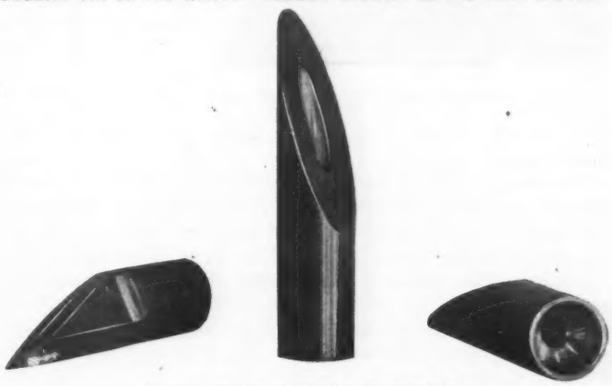


FIG. 2.—STEAM NOZZLES OF TURBINE.

ary guide plates form closed spaces in which the steam reacts, and the steam is returned again and again to the moving buckets, each time at reduced velocity. The steam finally escapes from the open-ended guide plates into the interior of the turbine case.

The bucket-wheel, or moving part, is made of a single forg-

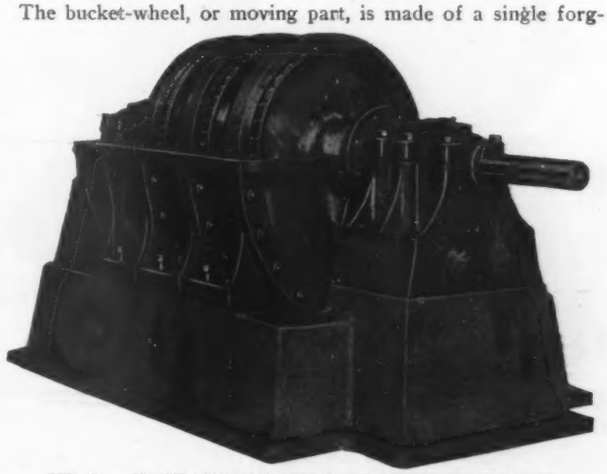


FIG. 3.—TURBINE WITH UPPER HALF OF CASING REMOVED.

ing with the buckets worked out of the solid metal on a special automatic bucket-cutting machine. This process insures a wheel of great strength, and as it runs between the two guide plates there is said to be no tendency to end thrust. A clearance of 1/16 in. all round the revolving wheel greatly re-

duces the liability of contact from lack of alignment, due to heating or wear of the bearings. The bucket-wheel is also made with buckets milled into the edges of the disc. In the latter form the steam acts tangentially.

The turbine is made of the single-stage type in ratings ranging from 10 to 200 horse-power, and adjustment of the nozzles and buckets permits a wide range of power and speed for a turbine of given outside dimensions. Sizes above 200 horse-power are usually made from two to four bucket wheels. The areas of the nozzles and buckets increase successively on

FIG. 4.—GOVERNOR AND BEARING OF SINGLE-STAGE TURBINE.

these wheels to take care of the larger volume of the expanded steam.

The speed of the turbine is controlled by a direct-connected throttle governor, consisting of four parts and one spring, located upon the end of the outboard bearing. The governor is enclosed in a dust-proof case, and is direct-connected to the regulating valve, which is placed upon the inlent beneath the governor.

The pressure upón the main bearings, which are of the self-aligning ring-oiling type with solid linings of phosphor bronze, is said to be but 14 lbs. per square inch, therefore, the wear is not appreciable.

The casing is made in halves so that the upper part can be removed easily for inspection of the bucket wheels; an annular

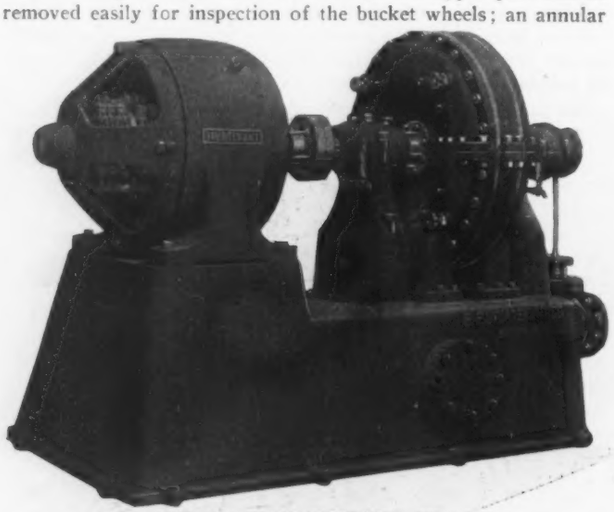


FIG. 5.—TURBO-GENERATOR SET.

passage supplies steam to the nozzles, and each nozzle can be shut off separately by means of a small valve. The deep base is utilized for carrying the steam and the exhaust, the respective pipes being connected directly to the base. The live steam passages in the base are also arranged to act as a surfaces. These locomotives are built in weights from 10 to 30 essential to the efficiency and the long life of the nozzles.

The turbine has the advantage of low speed ranging from 1600 to 300 r. p. m. In many turbines the speed is reduced by gears, or several bucket-wheels are mounted on the same shaft.

For installations in which the turbine is to be run non-condensing, no stuffing boxes are used on the shaft, steam tightness being secured by a water packing. Since there is no contact between the rotary and the stationary rings of this packing, no adjustments are necessary and the life of the packing is long.

Jamestown Exposition Awards.

Mr. James L. Farmer, secretary of the jury of awards, Jamestown Exposition, has notified the General Electric Company that it has been awarded two gold medals and a bronze medal on account of its exhibit at the exposition. The classification by which the jury was governed in granting the awards limited them to one in each department, while previous expositions have allowed separate awards for each class of material exhibited. The General Electric Company's exhibits are grouped in three departments, the Machinery, the Manufactures and Liberal Arts, and Mining.

A collection of motors applied to various machine tools and other devices was awarded a gold medal. The arc and incandescent lamps and electric cooking applications exhibited in the Departments of Manufactures and Liberal Arts were also awarded a gold medal. The company exhibited a special motor designed particularly for use with an Ingersoll-Temple pneumatic rock drill, and this motor, because of its peculiar adaptation to the special service, was awarded a bronze medal. The company was also awarded a silver medal for installation of exhibit.

Electric Switching Locomotive.

The accompanying illustration shows a 25-ton switching locomotive built by the Jeffrey Manufacturing Company, Columbus, Ohio, for use in handling freight cars for the Cerveceria Cuauhtenoc Brewery, of Monterey, Mexico. This locomotive takes the same electrical equipment as the mine type, the only changes being in the side and end frames and the addition of a platform and cab to meet the conditions incident to surface

SWITCHING LOCOMOTIVE.

work. The motors are of the waterproof steel-frame type, having drum-wound armatures, laminated pole pieces, oil lubrication with auxiliary grease boxes, and liberal wearing surfaces. These locomotives are built in weights from 10 to 30 tons with two motors, and in larger sizes with three and four motors, arranged with rigid frame, or with trucks having flexible wheel base.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—The country has made good progress in accommodating itself to the changed financial conditions wherein credit instruments are substituted for cash. At the same time, wholesale and jobbing trade was some quieter and there was an evident disposition in industrial lines to curtail production wherever possible. There was a more optimistic tone in business than during the previous week, which was the outgrowth of a better feeling at the East, the large receipts of gold from Europe and the belief that basic conditions are better than in some preceding years of stress. From the Northwest and the South numerous complaints are made of the difficulty of getting wheat and cotton to market on account of the scarcity of cash; but the general issuance of bank and corporation checks in small denominations has eased the currency situation very perceptibly. Collections were slower, but retail trade was stimulated by the cooler weather. In jobbing lines some reorder business is noted, and in wholesale lines a quieting down in purchases for future deliveries is reported. Business in iron and steel trade is practically at a standstill, pending the clearing of the financial situation. Wage reductions from 5 to 10 per cent have been announced. Steel bars, plates and bar iron are weaker, and in some instances buyers of wire products are requesting the postponement of deliveries. Copper reacted on realizing in London, and Lake and electrolytic brands declined to 14 cents and 13¾ cents. Business failures in October, as reported by *Bradstreet's*, number 964, with aggregate liabilities of $139,180,481. This is the largest number of failures reported since January, 1907; the heaviest total in October for ten years past and the largest liabilities ever reported in any month. Four-fifths of the liabilities were furnished by New York City and three-fifths were accounted for by suspending trust companies. The number of failures for the week ending Nov. 7 was 226, against 223 in the preceding week, and 146 in the corresponding week last year.

DELTA POWER PLANT DAM.—The Ambursen Hydraulic Construction Company, of Boston, Mass., has closed a contract with the Delta Electric Power Company, of Delta, Pa., for a reinforced concrete dam in southeastern Pennsylvania for supplying power to the quarries and other industries in that district. A similar contract has been closed by the same company with the Big Horn Power Company, of Chicago, Ill., for a dam on the Big Horn River in Wyoming. These two dams are almost exactly similar in dimensions and characteristics. Each dam is situated in a narrow gorge where there is no possibility of a detached or independent power house. The Wyoming dam will create a head of 60 ft. and the Pennsylvania dam a head of 65 ft., and both structures are about 70 ft. high above the foundations. The power houses in both cases will be under the rollway of the dam and protected by an inner shell. The great height of the dam allows ample space for a power house, together with traveling crane, switchboard, office, etc. Both dams will be of the half apron type. Work has been begun and will be carried on throughout the winter. It is expected to complete both dams before the spring freshets.

WESTINGHOUSE IN SAN FRANCISCO.—Despite the recent financial troubles of the home company, the San Francisco branch (controlling the Pacific Coast) of the Westinghouse Electric & Manufacturing Company is holding its own in the matter of sales. It reports that the three months ending Oct. 1, 1907, were the largest in its history. The orders for large types of machines were more numerous than ever, with some falling off in the trade in small motors. The lamp department showed satisfactory increase of business. The Westinghouse Machine Company is represented on the Pacific Coast by Hunt, Mirk & Company, of San Francisco, who report that they are not affected by the recent troubles, Their business continues to be satisfactory, and they have recently made some large sales of power machinery, including the installation of the new plant of the City Electric Company.

POWER FOR CENTRAL TEXAS.—It is stated by J. J. Henry and T. B. Burbridge, of Denver, Col., that they are making good progress with their preliminary plants for installing a great electric power plant near Austin, Tex., for the purpose of supplying a large number of towns of Central Texas with light and power. They will use lignite for fuel. They have secured options on extensive lignite fields in that section. More than $3,500,000 will be expended in installing the plant and in building the transmission lines. Some of these lines will be 200 miles long, and will extend to several of the larger cities of the state. Mr. Henry installed the Consolidated Power & Lighting plant at Deadwood, S. D., and the Northern Colorado Power Company's plant. Mr. Henry says that the latter plant is an exact parallel undertaking to what is contemplated in Texas. The Colorado plant is located on the lignite beds north of Denver. It supplies 25 cities and towns in Northern Colorado, besides furnishing electrical energy to the Colorado & Southern Railroad for its Northern Division.

POWER ENTERPRISES SUSPENDED.—Work has been suspended temporarily on the McCall's Ferry, Pennsylvania, power project and that of the Stanislaus River, California, on account of the tying up of funds in the embarrassed Knickerbocker Trust Company of New York. Early resumption of work is expected. When the McCall's Ferry project was started nearly two years ago the Knickerbocker Trust Company of New York became the trustee of the $10,000,000 mortgage put on the work. Bonds were issued immediately and the proceeds were deposited in the trust company as soon as they were sold According to a report, the McCall's Ferry Dam Company had $800,000 to its credit when the institution closed its doors. It is stated that some $3,000,000 has already been expended on the Stanislaus Power & Water Company's plant.

COLORADO RIVER POWER.—Charles H. Alexander, of Dallas, and associates, have acquired the falls in the Colorado River and Marble Falls and are arranging to install a large electric power plant there for the purpose of supplying Austin, Tex., and a number of other towns of the central part of the state with electrical energy. A 10-ft. cap will be built across the natural dam.

PUMPS FOR MANILA.—The Municipal Board, Manila, P. I., will receive bids until Jan. 15 for electrically driven pumps and motors for the new sewerage systems in that city. There will be one main station and five sub-stations, each equipped with two pumps and corresponding motors. Specifications may be obtained from either the Municipal Board or from the Bureau of Insular Affairs, Washington, D. C.

MANUFACTURE OF TYPEWRITERS.—The Oliver Typewriter Company has recently purchased new power and electrical units for the plant at Woodstock, Ill., comprising a 22 in. x 42 in. Allis-Chalmers horizontal heavy-duty Corliss engine direct connected to a 300-kw, 240-volt, direct-current generator of the same build for carrying the power and lighting load.

POWER FOR LAREDO.—Samuel Kahn, of San Antonio, is at the head of a company which is being organized to install a large electric power plant at the coal mines, 25 miles from Laredo, Tex. The energy will be transmitted to Laredo and used also for operating irrigating plants in the valley of the Rio Grande.

CRANES IN PRESS FACTORY.—The new foundry of R. Hoe & Co., printing press manufacturers, of New York, has been equipped with three 10-ton electric traveling cranes, each of about 65-ft. span, furnished by the Northern Engineering Works, Detroit, Mich.

TELEPHONES FOR AUSTRALIA.—The Postmaster-General's Department, Adelaide, South Australia, will receive bids until March 11, 1908, for the supplying of one common battery switchboard, 400 subscribers' telephones and 400 protectors.

WIRELESS.—The steamship "Joseph Vaccaro," of the Vaccaro Brothers Steamship Company, trading from New Orleans to the Spanish Main, has been equipped with the DeForest system of wireless telegraphy.

BARTOW, FLA., MUNICIPAL PLANT.—The electric light and water plant of the city of Bartow, Fla., under the superintendency of Mr. Eugene Bivins has, it is claimed, experienced a prosperous growth. Within the past two years, it is stated, the number of patrons has more than doubled and at the present time the plant capacity is taxed to its utmost. The equipment in the municipal plant at Bartow includes an Allis-Chalmrse direct-connected generator. This unit was installed four years ago, and, according to the attendants, has never given a particle of trouble. The Bartow plant gives only a night service, of 14 hours' duration,, and there has been but a single shut down in two years chargeable to the engine. Practically no repairs have been required since installation, a single set of new brushes for the exciter covering everything chargeable to the electrical equipment. The population of Bartow is 2000.

COPPER CONDITIONS are steadily improving, from one point of view, on account of the restriction of output and the cleaning up of the metal now on the market. On the New York Metal Exchange this week, Lake has been quoted at 14 to 14¼ cents, electrolytic 13¾ to 14¼ cents, and castings 13¼ to 13¾ cents. There seems little doubt as to the sale of 112,000,000 lbs. by the United Metals Company to a foreign pool of consumers. This week the price of aluminum has been lowered by the manufacturers from 45 cents a pound to 40 cents.

Financial Intelligence.

THE WEEK IN WALL STREET.—On the stock market there was a better feeling, but speculative operations were discouraged by all conservative interests. There was, however, considerable investment buying, mainly in small lots. A better feeling in Wall Street resulted from the settlement whereby the Tennessee Coal pool was relieved of its burden and the property transferred to the control of the United States Steel Corporation. The announcement of this deal caused an exhibition of strength in Steel shares, but later in the week sales of the Steel bonds received in exchange for Tennessee Coal stock caused them to fall to 80. More strength was shown in electrics, with general advances. Westinghouse furnished the most prominent exception and declined from 54 to 49—a net loss of, 5 points. General Electric made a net gain of 6⅝ points at the close of the week. The general market was then steady. The curb market was dull and irregular throughout the week, but the heavy liquidation appeared to be over. Following are the closing quotations of Nov. 12:

NEW YORK.

	Nov. 4	Nov. 11		Nov. 4	Nov. 11
Allis-Chalmers Co.....	5¼	5¼	General Electric 110		112
Allis-Chalmers Co. pfd..	14⅜	14½	Hudson River Tel.....	—	—
Am. Dist. Tel.....	—	20	Interborough Met. com.	5¾	5⅝
American Locomotive...	39	39	Interborough Met. pfd..	16	17½
Amer. Locomotive pfd.	86½	92½	Mackay Cos.	48½	47
American Tel. & Cable.	65	60	Mackay Cos. pfd.....	50	53
American Tel. & Tel...	—	92	Marconi Tel.	—	—
Brooklyn Rapid Transit.	30¼	31½	Metropolitan St. Ry...	—	20
Electric Boat	—	—	N. Y. & N. J. Tel.....	—	96
Electric Boat pfd.....	—	—	Western Union Tel....	63	64
Electric Vehicle	—	—	Westinghouse com.....	54	44
Electric Vehicle pfd...	—	—	Westinghouse pfd.....	—	160

BOSTON.

	Nov. 4	Nov. 11		Nov. 4	Nov. 11
American Tel. & Tel...	93½	92	Mass. Elec. Ry. pfd...	39	40
Cumberland Telephone..	96¼	—	Mexican Telephone.....	—	1¼
Edison Elec. Illum.....188		195	New England Telep....	—	98½
General Electric	—	—	Western Tel. & Tel.....	—	4
Mass. Elec. Ry.....	9⅞	9¾	West. Tel. & Tel. pfd..	53	53

PHILADELPHIA.

	Nov. 4	Nov. 11		Nov. 4	Nov. 11
American Railways	44	44½	Phila. Electric	6⅞	6⅞
Elec. Co. of America...	8	8	Phila. Rapid Transit...	15⅞	16
Elec. Storage Battery...	31	30	Phila. Traction	—	83
Elec. Stor. Battery pfd.	—	—			

CHICAGO.

	Nov. 4	Nov. 11		Nov. 4	Nov. 11
Chicago City Ry.....140		140	National Carbon	—	50
Commonwealth-Edison ..	—	80	National Carbon pfd...	—	99
Chicago Subway	—	12¾	Union Traction	—	—
Chicago Tel. Co.....	—	110	Union Traction pfd....	—	—
Metropolitan Elec. com..	19*	19*			

*Asked

DIVIDENDS.—Directors of the Georgia Railway & Electric Company have declared the regular quarterly dividend of 1½ per cent on the common stock, payable on Nov. 20. Niles-Bement-Pond Company has declared the regular quarterly dividend of 1½ per cent on the preferred stock of the company, payable Nov. 15. Pratt & Whitney Company has declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable Nov. 15. The directors of the Chestnut Hill Railroad Company declared a quarterly dividend of 1½ per cent, payable Dec. 4, to stock of record Nov. 20. Directors of the American Telegraph & Cable Company have declared the regular quarterly dividend of 1¼ per cent, payable Dec. 2. The directors of the Pittsburg & Butler Telephone Company have declared a dividend of 16 per cent from the past year's earnings. The company is a subsidiary of the Pittsburg & Allegheny Telephone Company. The dividend in 1906 was 6 per cent. Directors of the Consolidated Gas Company, of New York, have declared a regular quarterly dividend of 1 per cent, payable Dec. 16.

GENERAL ELECTRIC SALES.—A comparative statement of General Electric orders received from and sales billed to customers for the first nine months of each of the past five years is as follows:

ORDERS RECEIVED.

1907	$49,677,500
1906	45,395,887
1905	38,042,489
1904	26,301,141
1903	30,562,915

SALES BILLED.

1907	$55,728,040
1906	41,774,812
1905	29,346,567
1904	28,252,962
1903	30,131,341

On Oct. 30 the General Electric completed the first three-quarters of the current fiscal year to end Jan. 31 next. Gross sales billed in this nine months will exceed $55,000,000, as compared with a little less than $42,000,000 in the corresponding period of 1906. In the three months ended Oct. 30 the General Electric broke all previous records in the total amount of goods billed out, the aggregate being nearly $20,000,000 or $4,000,000 greater than for the same three months of 1906. The comparison of the goods billed in the first three-quarters of the current and 1906 fiscal year shows as follows:

	1907-1908.	1906-1907.	Increase.
First six months.....	$35,406,878	$25,915,762	$9,491,116
August	6,100,000	5,200,000	900,000
September	6,750,000	4,945,000	1,805,000
October	7,100,000	5,900,000	1,200,000
Total	$55,356,878	$41,960,762	$13,396,116

In the twelve months ended Jan. 31 last the General Electric billed a total of $60,071,883 of electrical apparatus. In the next three months, therefore, the company will have to ship but $5,000,000 of goods in order to equal the record of the previous year. As a matter of fact, it now seems likely that the total sales billed for the year will not fall far short of $70,000,000.

NORTH AMERICAN REPORT.—The North American Company has issued a statement in which it says: "In view of the disturbed financial conditions now prevailing, the directors have decided to defer the declaration of the dividend for the present." The income account of the company for the 10 months ending Oct. 31, 1907, is as follows:

RECEIPTS.

Interest received and accrued.....	$232,005	
Dividends received	1,179,328	
Compensation for services.....	23,316	
		$1,434,649

EXPENSES.

Salaries, legal expenses, rent and other expenses of administration	$74,576	
Interest paid and accrued.....	66,193	
Taxes	5,260	
Losses	10,000	
		156,029
Net income		$1,278,620
Three quarterly dividends paid		1,117,212
Surplus for the ten months.....		$161,408
Undivided profits, as of Oct. 31, 1907.....		4,160,956

The loans which the company has made to the various companies in which it is principally interested, for extensions and additions chargeable to its capital account, amount as of Nov. 7, 1907, to $3,612,938. Repayment on account of these advances has been depended upon by the North American Company as required to pay its own dividends. At the moment these companies are unable to comply with this requirement, because of their inability to sell, except at great sacrifice, their own mortgage bonds, which have been issued and are available to reimburse their treasuries for capital expenditures heretofore made, or to make loans on reasonable terms. In order to pay a dividend on Dec. 1, the North American Company would either be obliged to require these companies to make payment to it on account of their loans (which, as stated above could only be done at great sacrifice) or would itself be obliged to borrow money for the purpose.

WESTERN ELECTRIC BONDS.—At the special meeting of the Western Electric stockholders, held in Chicago, when a vote was carried to issue $15,000,000 bonds, President Barton made a statement calling attention to the fact that the accounts receivable, plus cash and merchandise combined, is over three times the amount of bills payable. Inventory of finished merchandise, work in process and new material Oct. 1, is estimated at $22,000,000. He says that the rate of production of telephone apparatus at factories is still somewhat in excess of orders, although the number of employees has been reduced 39.9 per cent. "We know, however, that our telephone customers are using up their own stock to such an extent that we believe they will soon be placing more orders than at present. We expect that additional business from present telephone customers, together with sales to independent telephone companies, to whom we are now prepared to sell apparatus freely, will require the present rate of production to be increased, and consequently additional hands to be employed." President Barton preferred a stock issue, but it was impracticable to put out stock sufficient to make any inroads into indebtedness. The determining question with the board, he said, was that the larger number of stockholders are not in a position to take their proportion of new stock. The question of interest is not paramount. At present rates the company is paying, the interest on this $15,000,000 would equal a shade over 6 per cent. Bonds cannot be sold in the immediate future except below par "Our collections have been excellent all this year and still are excellent. Our customers are not behind ordinary normal conditions, but we have about $15,000,000 indebtedness, or amount of our capital, and if we took out our cash balance it would still be between $11,000,000 and $12,000,000. Our quick assets are over three times our indebtedness, but we can't realize on merchandise or receivables all at once." The company has in its business practically $35,000,000. Its capital last year was turned over twice. The surplus is now between 19 and 20 millions. Bills payable on Oct. 1 were $15,347,000, a decrease of $7,534,000; cash $3,733,000, an increase of $2,106,000. Total bills payable, less cash, $11,615,000, a decrease of $9,640,000. Accounts receivable and undiscounted bills receivable on hand Oct. 1 were $12,838,000, a decrease of $7,484,000, compared with Dec. 1, last year. The Western Electric annual report shows sales for the first six months of 1907 equal to $29,614,000, or 1 3/10 per cent more than for the previous year. Sales for four months ending Sept. 30 were $15,745,000, or 35 1/10 per cent less than previous year. Total number of employees Oct. 1 was 16,183, a decrease of 39.9 per cent compared with Dec. 1, 1906.

LAKE SUPERIOR CORPORATION.—It would appear that there is a fight on for the control of the Lake Superior Corporation, a $40,000,000 company, which arose three years ago from the wreck of the old Consolidated Lake Superior Company, that collapsed in 1903. Strong Philadelphia interests are at work to overthrow Charles E. Orvis and Francis H. Clergue, who have been on the board since the reorganization. Before the organization of the present company a syndicate of New Yorkers, headed by Speyer & Company, lent the Consolidated Lake Superior Company $5,050,000. Upon the company's failure to pay this money the company's assets were sold under foreclosure, and the syndicate bought them in. A number of the syndicate members were interested in the Canadian Improvement Company, and it was this company which largely liquidated the debt. The entire $5,050,000 has been paid. The directors of the Lake Superior corporation announced a month ago that the company would not make a payment this year on the $3,000,000 issue of income 5 per cent bonds, which were put up at the time of the reorganization of the old company. This decision, it was said, was not the result of earnings, but was due to the desire of the directors to use all of the company's funds in its business.

NATCHEZ RECEIVERSHIP.—W. A. Pollock, of Vicksburg, has been appointed receiver for the Southern Light & Traction Company, of Natchez, Miss., the local property of the Southern Electric Securities Company, the latter company having been adjudged a trust by Chancellor Hicks in a case before him at the last term of the Warren County Chancery Court. The company is conducting an electric light and gas plant and electric street railway system in Natchez, and has similar property in Vicksburg, Jennings, La., and Beaumont, Tex. There is little local capital in the property, though the Natchez end was organized by Natchezians. The property will be operated by the receiver, with W. B. Moorman continuing as superintendent. The application for a receiver was made by Harry K. Johnson, of Vicksburg. The receivership grew out of the late litigation, culminating in the recent decision of the Supreme Court in the case of S. S. Bullis vs. the Southern Electric Securities Company, in which the Supreme Court held the company to be a trust and combine, and operating in violation of the laws of the State.

WESTINGHOUSE BONDS.—Kuhn, Loeb & Company, who acted as bankers for the Westinghouse Electric & Manufacturing Company, have requested the holders of the convertible sinking fund 5-per cent bonds and of the 3-year 6-per cent collateral trust notes of that company to communicate with them. At the company's office last week it was said that the request had been issued merely for the purpose of bringing the holders of these securities into touch with Kuhn, Loeb & Company to watch any developments in plans for the rehabilitation of the Westinghouse Company. It was said that the bankers had no knowledge of any proposed plans of readjustment or whether a general reorganization of the Westinghouse Company would take place. The three-year collateral trust notes were issued only a few months ago to take the place of a previous issue. The present issue has nearly three years to run. Kuhn, Loeb & Company already represent a large amount of the Westinghouse notes and bonds.

ISSUES AUTHORIZED.—The New York Public Service Commission, Second District, has authorized the Newport Electric Light & Power Company to construct lines in the town of Newport and in the village of Poland, Herkimer County, and to issue a mortgage to secure the payment of thirty-year bonds amounting to $75,000, the proceeds to be used for retiring $15,000 of bonds outstanding and the balance for construction and equipment. The Commission has given permission to the Dutchess Light, Heat & Power Company, of Rhinebeck, N. Y., to construct extensions of its lines in the towns of Red Hook and Hyde Park, Dutchess County, and for authority to issue $20,000 capital stock, to be devoted to the acquisition of land and construction and extension of its plant.

IDAHO POWER CONSOLIDATION.—Advices from Pocatello, Idaho, state that the Idaho Consolidated Power Company, with a capital of $2,000,000, has absorbed the American Falls Power, Light & Water Company, the Pocatello Electric Light & Power Company and the Blackfoot Power & Water Company. The formal transfer of these holdings to James H. Brady, of Pocatello, will be made at once. Mr. Brady retains the presidency of the consolidated company. The plans include the development of the Consolidated's 50,000 horse-power at American Falls and transmission of electrical energy to the surrounding towns. Twenty-five hundred horse-power is now being generated at American Falls, and an additional 4000 can be delivered inside of sixty days.

SHAWINIGAN POWER.—Directors of the Shawinigan Water & Power Company recently declared an initial dividend of 1 per cent on the common stock. About $7,000,000 of cash has gone into the enterprise and this cash is represented by $5,000,000 of bonds which have been selling on the London Stock Exchange around par, $1,000,000 of debenture stock, also listed in London, selling around 90, and $6,500,000 of common stock which has been selling in the neighborhood of 50. The company is now generating about 72,000 hp and is delivering 14,000 hp daily to the city of Montreal. It has 300 miles of transmission line, including two cables under the St. Lawrence River.

UTAH INDEPENDENT TELEPHONE.—The United States Independent Telephone Company of Rochester, N. Y., has sold the Utah Independent Telephone Company, one of its subsidiary corporations, to R. L. Day & Company, investment bond dealers of New York City. The price paid was $910,000, which, with $50,000 forfeited by Elmer R. Jones, representing Salt Lake City capitalists who took options some time ago on this property makes the sum realized for the Utah holdings $960,000.

CANADIAN GENERAL ELECTRIC.—The stockholders of the Canadian General Electric Company have voted in favor of the issuance of $2,000,000 of preferred stock, carrying with it a preference as to assets as well as dividends. The new issue was entirely underwritten, but stockholders could subscribe in proportion to their holdings.

GENERAL NEWS

Construction News.

BIRMINGHAM, ALA.—The Greater Birmingham Electric Light & Power Company has been incorporated to build a power plant on Village Creek for the purpose of supplying electricity for lighting purposes. The company plans to build a power plant of 1000 horse-power on the creek in North Birmingham. It is capitalized at $196,000 and will apply for franchises in the various municipalities in the Birmingham district. J. M. Bradley, formerly with the Birmingham Railway, Light & Power Company, is president of the company.

HEADLAND, ALA.—An election will be held Dec. 1 to vote on the proposition of issuing $23,500 in bonds for the construction of an electric light plant and water works system. The city previously authorized an issue of $20,000 in bonds for this purpose, but the amount is claimed to be insufficient.

PRESCOTT, ARIZ.—C. E. Miesse, president of the Octave Mining Company, states that a plant will be installed to furnish power for the various mining companies in the district near Wickenburg on the Hassayampa.

YUMA, ARIZ.—The Board of Supervisors has granted Thomas Drennan a permit to maintain and operate a telephone system on the county roads for a term of 25 years.

ALAMEDA, CAL.—The electric light commissioners have awarded the contract for the construction of the power house for the municipal electric light plant for $25,495. The building is to be of reinforced concrete and will be erected on Park Street.

AZUSA, CAL.—The San Gabriel River Dock Company is planning to install a 50-hp electric motor at its stone crushing plant. A second crusher will be built on the Pacific electric line about Jan. 1.

BISHOP, CAL.—The Bishop Light & Power Company is contemplating making additions and increasing the capacity of its plant. E. Robinson is president.

GRASS VALLEY, CAL.—Arrangements are being made by the California Gas & Electric Corporation to resume work on the Deer Creek power plant. It is expected that the plant will furnish 8000 horse-power within two months. John A. Britton, of San Francisco, is president of the company.

HERMOSA BEACH, CAL.—The Hermosa Beach Improvement Association has pledged itself to secure a municipal electric lighting plant for this town. A committee consisting of G. Scoles, A. C. Moore and Theodore Haneman has been appointed to work for the project. The cost of the plant is estimated at $15,000.

LOS ANGELES, CAL.—Arrangements have been made whereby the Los Angeles Railway Company agrees to extend the Eagle Rock line west into Glendale, a distance of two miles.

LOS ANGELES, CAL.—The Union Home Telephone Company, controlling the independent systems of ten Southern California cities, has made public an arrangement whereby its interests have been combined with those of the United States Long Distance Telephone Company. J. M. C. Marble, president of the Union Home Company, has resigned, and Frank W. Wachter has assumed the management of both corporations. The amalgamation, it is expected, will be ratified by the stockholders of the two companies at the annual meetings in January.

OAKLAND, CAL.—The Bay Counties Power Company has announced its plan of stringing a double transmission line into Oakland from its Yuba County power plant, and of generating electricity at the power plant of the Oakland Gas, Light & Heat Company at First and Grove streets. The Bay Counties Power Company is planning to furnish electricity in the towns along the route of the transmission line, but the greater portion of the supply will be distributed in Oakland.

SAN BERNARDINO, CAL.—Bids will be received by the Board of County Commissioners until Nov. 25 for a franchise to erect poles and wires for the transmission of electricity for heat and power on certain streets. Charles Post is clerk of the board.

SANTA ANA, CAL.—The Orange County Coal Mining Company is contemplating the installation of a power plant to use at its mine. Dr. J. A. Kronkhite, of Los Angeles, is president of the company.

STOCKTON, CAL.—Manager Buck, of the Union Construction Company, which has been building the reservoirs, mills, pipe line, plant and wire lines of the Stanislaus Power & Water Company in Tuolumne and Calaveras counties, but was compelled to cease operation recently owing to the failure of the Knickerbocker Trust Company, of New York, N. Y., has announced that the corporation expects to resume work on the power system inside of thirty days.

WILLOWS, CAL.—The plant and holdings of the Willows Water & Light Company has been purchased by the Northern California Power Company, of Redding. This gives the latter company control of the water and light systems in Redding, Red Bluff, Corning, Orland and Willows. The Northern California Power Company has furnished electricity for operating the Willows plant for several years. Samuel Boyd, of Corning, will have charge of the plant.

DENVER, COL.—The Denver & Intermountain Railway has been purchased by a syndicate headed by Daniel Chase, which has secured a right of way for the new electric line from Englewood to Roxborough Park. The Intermountain road will be operated by electricity. The new company will expend $2,000,000 for improvements to the line.

LAS ANIMAS, COL.—Bids will be received until Nov. 23 at the Bureau of Yards and Docks, Navy Department, Washington, D. C., for power plant, building and machinery at U. S. Naval Hospital, New Fort Lyon, Col. William M. Smith is acting chief of bureau.

TRINIDAD, COL.—The Trinidad Electric Railroad Company is contemplating building an extension from Sparis to Cokedale.

BRANFORD, CONN.—The Connecticut Company is planning to install an alternating current day service about June 1, 1908. E. T. Gilbert is superintendent.

NEW HAVEN, CONN.—Surveys are being made by the Connecticut Company for an extension of its line from Lighthouse Point along the shore to South End and then connecting with the Branford electric line at some further point not yet decided upon.

WILMINGTON, DEL.—The Wilmington Light, Power & Telephone Company has been granted permission to build an additional conduit on Eighth and Shipley streets.

ATLANTA, GA.—Upon petition of the American Circular Loom Company, Judge Pendleton on Oct. 25 appointed T. A. Burke co-receiver with F. M. Laxton, of the Southern States Electric Company. The petitioning company requested that the additional receiver be appointed to represent its interest and the interest of other creditors.

COLUMBUS, GA.—Charles E. Main and John E. Porter, consulting engineers of the Stone & Webster syndicate, of Boston, Mass., have been in the city recently and made an inspection of the power house of the City Mills, with a view of making improvements to increase the capacity of the plant, which is leased by the Columbus Railroad Company. They also inspected the water power of the Eagle and Phoenix mills, which is to be greatly improved.

MONROE, GA.—The city is contemplating holding an election to vote on the proposition of issuing $30,000 electric light and sewer bonds.

SPARKS, GA.—The citizens on Nov. 5 voted in favor of issuing $20,000 in bonds to provide for funds for an electric light plant and water works system.

MOSCOW, IDAHO.—H. H. Robinson, city clerk, writes that the question of constructing a municipal electric power and lighting plant has been discussed by the City Council, but nothing definite has yet been done.

NAMPA, IDAHO.—A new electric pump is being installed at the water pumping station by the Baker City Iron & Supply Company. The cost of pumping water with electric power will be $160 a month, which is about $75 less per month than the cost by steam power.

CENTRALIA, ILL.—The Centralia Gas & Electric Company is planning extensive improvements to its plant, and will change its system from the two to the three wire and increase the boiler capacity. G. E. Fish is superintendent.

CHICAGO, ILL.—The Dearborn Street Improvement Association has decided to install 78 luminous arc lamps on Dearborn Street. Plans for lighting the street have been approved by William Carroll, city electrician.

CHICAGO, ILL.—The Drainage Board expects to begin on Dec. 1 to supply electricity generated at Lockport to the city of Chicago and the other municipalities with which contracts for power have been made. The municipalities which, it is expected, will be ready to take electrical energy, are: City of Chicago, 6000 kw; West Park Board, 900 kw; township of Cicero, 15 kw, and the village of Morgan Park, 112 kw. The Sanitary District, which is to receive $15 per horse power per year for the sale of electric power, expects to be able to supply 11,000 kw at the outset. About 4500 kw will be furnished to the Union stockyards firms.

DANVILLE, ILL.—Sealed proposals will be received until Dec. 4 at the office of the treasurer, Danville Branch, N. H. D. V. S., Danville, Ill., for furnishing materials, labor, etc., for installing a telephone system at the Danville Branch, N. H. D. V. S., in accordance with instructions and specifications, copies of which, with blank proposals and other information, can be secured upon application to M. J. Barger, treasurer.

CRAWFORDSVILLE, IND.—The Chicago & Western Indiana Traction Company has been granted a franchise by the Commissioners of Montgomery County to construct and operate an electric railway through the county. This grant completes the right of way for the entire route, and it is said that work on the construction of the road will soon commence.

FORT WAYNE, IND.—It is reported that the Fort Wayne Power Company, recently incorporated, will take over the plant and holdings of the old Fort Wayne Water Power Company.

GOSPORT, IND.—The Gosport Electric Light & Power Company, which was recently incorporated to build and equip an electric light plant in this town, informs us that contracts have been placed for the plant. W. A. Montgomery and J. S. Davis are among the directors.

NEW ALBANY, IND.—The United Gas & Electric Company, through its general manager, Martin Insull, has asked for permission to install 50 lamps of a new and improved system on Elm and other streets in the city as a test. The company proposes to operate these lamps for 90 days, and if not satisfactory, they are to be removed and replaced by the lamps now in use.

NEW ALBANY, IND.—The United Gas & Electric Company has announced a reduction in its prices for incandescent lighting, taking effect from Nov. 1. The reduction to smaller consumers will be about 20 per cent.

PLYMOUTH, IND.—The Indianapolis, Logansport & South Bend Railroad Company has been granted a franchise by the Commissioners of Marshall County to construct and operate an electric railway on the Michigan road through the county. The franchise is for a term of 99 years and the road must be completed within a year. The City Council recently granted the company a franchise within the city limits.

WILKINSON, IND.—The Wilkinson Switchboard & Telephone Company, recently incorporated, is in the market for material, equipment and labor for the construction and installation of a new telephone plant.

TULSA, I. T.—The Tulsa Interurban Railway Company has applied to the City Council for a franchise to operate an electric railway on certain streets in the city. The company proposes to build an electric railway from Sapulpa to Tulsa by the way of Red Fork and the Glen Pool, and thence to Broken Arrow. John O. Mitchell, L. D. Marr, H. R. Cline, G. N. Wright are interested in the enterprise.

CEDAR RAPIDS, IA.—The Cedar Rapids & Iowa City Railway & Light Company is contemplating enlarging its boiler room and equipment, including coal and ash-handling apparatus, chain grates, conveyers, etc., and possibly economizers. W. J. Greene is manager.

ELKADER, IA.—The Turkey River Power & Improvement Company is contemplating the construction of three dams, and also proposes to build an interurban line from Elkader to Oelwein and Dubuque.

KEOTA, IA.—Robert Morris, who recently purchased the local electric light plant, is planning to install new machinery.

VALLEY JUNCTION, IA.—The Valley Junction Water & Light Company is contemplating increasing the equipment of its plant, and will install new boilers and engine. R. M. Lewis is superintendent.

BALTIMORE, MD.—The Consolidated Gas, Electric Light & Power Company is contemplating making extensive improvements to the Penn Street substation. P. O. Keilholtz is consulting engineer.

FITCHBURG, MASS.—The Fitchburg Gas & Electric Light Company is making arrangements to place its wires underground in the business section of the city. The company recently placed a large order with the General Electric Company for underground cable.

MERRIMAC, MASS.—At a special town meeting held recently the citizens voted to make additions to the municipal electric light plant to cost $6,000. It is proposed to increase the equipment of the plant to furnish electricity for motors, for which the demand is increasing.

OXFORD, MASS.—The Webster Electric Company has commenced work on the extension of its line from Texas village, North Oxford to Cominsville, for the purpose of furnishing the village of Cominsville with electric light.

STOCKBRIDGE, MASS.—The Stockbridge Lighting Company has completed the construction of its lines. Electricity for operating its system is purchased from the Glendale power station, which is operated by the Monument Mills Company, of Housatonic. The company has not made any contract for lighting the streets of the town as yet. Charles E. Hull is treasurer and general manager.

TURNERS FALLS, MASS.—The Selectmen have granted the Franklin Electric Light Company a franchise to maintain a pole line to Millers Falls for the purpose of supplying that village with electricity. The Millers Falls fire district has made a contract with the company to furnish electricity for a term of ten years, and will abandon the municipal power plant.

WINCHENDON, MASS.—The Winchendon Electric Light & Power Company is contemplating the installation of an auxiliary plant in connection with its present water power plant. Frank W. Nourse is manager.

WORCESTER, MASS.—The Worcester & Holden Street Railway Company has been granted permission by the Railroad Commissioners to issue $40,000 additonal capital stock at par.

ADRIAN, MICH.—The Schwarze Electric Company has increased its capital stock from $25,000 to $40,000.

BERRIEN SPRINGS, MICH.—We are informed that the C. L. Olds Construction Company, of Fort Wayne, Ind., on Nov. 7, was awarded the contract for 4¾ miles of wire, regulator for 25 street lamps, transformer and erection of poles, wire, etc., for the municipal electric lighting system for $3,220.

LUPTON, MICH.—The capital stock of the Ogemaw Telephone Company has been increased from $2,500 to $5,000.

ONAWAY, MICH.—The Onaway Light & Power Company is contemplating the construction of a new dam next year to meet the increased demands made on its plant. W. W. Vaughn is president.

ANOKA, MINN.—Application has been made by the American Trust & Saving Bank, of Chicago, Ill., for a receiver for the Anoka Water Works, Electric Light & Power Company. The application is made on the ground that the plant has not been kept up and extensive repairs are necessary. The plaintiffs ask that in case the motion is granted, Frank H. Philbrick, the present manager, be appointed receiver.

FERGUS FALLS, MINN.—The farmers of Leaf Lake will form the Otter Tail Telephone Company. H. H. Brutlag is secretary.

MONTICELLO, MINN.—Two rural telephone companies have been organized here recently known as the Pelican Lake Telephone Company and the Prairie Rural Telephone Company, which makes five telephone companies operating in Monticello.

NASHWAUK, MINN.—The Village Trustees are contemplating increasing the equipment of the municipal electric light plant by the installation of an 80-kw alternator with engine and other necessary apparatus, and also the extension of lines to two mines. G. A. Lindsay is superintendent.

STEWARTVILLE, MINN.—The Stewartville Electric Light Company is contemplating making improvements and increasing the equipment of its plant. A new dynamo and other machinery will be installed.

VIRGINIA, MINN.—The Virginia Light & Water Company is contemplating the installation of a 100-kw alternating-current, 2300-volt direct connected unit in its plant. O. H. Griggs is manager.

CANTON, MISS.—The citizens are contemplating the purchase of a 50-lamp transformer for the municipal arc lighting system, and the extension of fire main to the corporate limits. John T. Sharp, Jr., is manager.

HUNTSVILLE, MO.—C. F. Roberts, manager of the Huntsville Light & Power Company, will soon apply for a franchise in the city of Moberly to operate an electric lighting system and street railway. Mr. Roberts was recently granted a right of way for an electric railway over the public highway between Huntsville and Moberly.

MARYSVILLE, MO.—Preliminary plans and estimates have been prepared by Burns & McDonald, of Kansas City, for the construction of an electric light plant for this city, to cost about $10,000. Bonds have not yet been sold.

MEMPHIS, MO.—The Iowa-Missouri Traction & Power Company is contemplating the construction of two dams across the Des Moines at Keesauqua, Ia., to develop water power for an electrical plant of 9000 horse-power. The plant will furnish electricity for lighting and operating a railway system. D. Fitzgerald, of 80 Wall Street, New York, N. Y., will finance the enterprise. A. W. Carpenter, of Memphis, can give further information.

STEELVILLE, MO.—A franchise has been granted to Janus Bright to furnish electricity in this town for a term of twenty years. The power house wil be located one mile east of the city. Water power will be used.

NORTH PLATTE, NEB.—The North Platte Electric Light & Power Company is contemplating making extensive improvements to its plant. The company was recently granted a 20-year franchise by the City Council.

PAPILLION, NEB.—At a town meeting held recently the citizens voted in favor of establishing an electric light plant.

PLATTSMOUTH, NEB.—The City Council has awarded a contract and franchise for operating an electric lighting system and for furnishing street lighting to Earl C. Wescott, of Plattsmouth. Electricity for operating the system will be furnished by the Omaha Electric Light & Power Company, which will construct a transmission line from Omaha to Plattsmouth River, opposite Plattsmouth. Arc lamps will be used in the business section of the city, and tungsten incandescent lamps will be placed in the residence districts. No contracts have been placed for any of the material needed for the plant.

STELLA, NEB.—The Stella Electric Light Company has closed a contract with the city for street lighting for a term of years, and will begin work at once installing a plant. Power for operating the plant will be furnished by the meal mills. John Brenner, of Humboldt, will be the electrician.

WOOD RIVER, NEB.—The City Council has voted to issue $18,000 in bonds for the construction of a combined electric light and water plant.

ALPHA, N. J.—The Alpha Cement Company is making arrangements to construct a power plant along the Pennsylvania side of the Delaware River, near Foulrift, next spring. The plans call for the construction of a canal 40 or 50 feet wide and three miles in length for the generation of electricity to operate its mills.

BRANCHVILLE, N. J.—The new electric lighting plant has been completed and was put into operation for the first time Oct. 26. The plant has an output equivalent to 40,000 candle power and is operated by water power. The old plant has been discarded and is for sale. The new plant was constructed by Charles H. Crisman, who has installed lighting systems in Sussex, Stanhope, Andover, Blairstown and Branchville.

NEWARK, N. J.—Work has commenced on the installation of the municipal electric lighting plant which will be installed in the basement

of the city hall. The equipment will include three Corliss engines and three generators, and the plant will have an output of 300 kw. The cost of the plant will be $28,904. James M. Seymour, Jr., is engineer.

SANTE FE, N. M.—M. H. Fisher has made application for water rights on Fresnal Creek, a tributary of La Luz Creek, for the purpose of erecting an electric power plant.

SOCORRO, N. M.—It is reported that plans and estimates are being considered for the construction of an electric light plant in this place. If the present plans are carried out the plant will be owned by the city.

ATTICA, N. Y.—Notice has been served upon the Attica Water, Gas & Electric Company by the clerk of Board of Trustees that unless the company makes arrangements by which sufficient fire protection can be afforded the village, the board will not renew its contract with the company under the present terms.

BINGHAMTON, N. Y.—The State Commission in Lunacy and the board of managers are considering plans for extensive improvements to the Binghamton State Hospital, among which is included the complete reconstruction of the light, heat and power plants and system, for which an appropriation of $60,000 is now available.

CORNWALL-ON-HUDSON, N. Y.—Edward Wiltgen, superintendent of the Hudson Counties Gas & Electric Company, writes that the company is changing the transmission e. m. f. from Newburg from 2000 volts, two-phase to 6000 volts, three-phase. The company is abandoning its old steam station, which was used as a sub-station, for its new sub-station, which is more centrally located.

HORNELL, N. Y.—The Hornellsville & Canisteo Railway Company is planning to purchase considerable equipment and cars. G. T. Rehn is general manager.

LIMA, N. Y.—The Lima-Honeoye Electric Light & Railroad Company is planning to place contracts within the next six months for the construction of about 26 miles of track, and is also contemplating the erection of a new power station to be located in the gas fields, four miles south of the city, where the company can produce gas at a cost of not exceeding five cents per 1000 cu. ft.

LOCKPORT, N. Y.—The Public Service Commission in the Second District, on Nov. 10, made public its decision in connection with the merger of the lighting companies in Lockport. The decision permits the new corporation, the Lockport Light, Heat & Power Company, to purchase the Lockport Gas & Electric Company and the Economy Light, Fuel & Power Company, of Lockport. It forbids the new company, however, to issue securities for a capitalization above $700,000, equivalent to the total issues of the two old companies. The new company desired to issue stock and bonds to a total of $1,200,000.

NEWPORT, N. Y.—The Newport Electric Light & Power Company has been granted permission by the Public Service Commission, second district, to construct transmission lines in the town of Newport and the village of Poland, and to exercise its rights and privileges in those places. The Commission also authorizes the company to issue a mortgage to secure the payment of bonds amounting to $75,000, the proceeds to be used for retiring $15,000 in bonds outstanding and the balance for construction and equipment.

RHINEBECK, N. Y.—The Public Service Commission, second district, has granted the Dutchess Light, Heat & Power Company authority to extend its transmission lines to the towns of Red Hook and Hyde Park, and also permission to issue $20,000 in capital stock to be used in the acquisition of land and construction and extension of its plant.

RHINEBECK, N. Y.—R. Raymond Rikert, secretary of the Dutchess Light, Heat & Power Company, writes that plans for the proposed extension are not yet complete.

ROCHESTER, N. Y.—The United States Independent Telephone Company has sold the Utah Independent Telephone Company, one of its subsidiary corporations, to R. L. Day & Company, of New York City. The price paid was $910,000.

UTICA, N. Y.—The Public Service Commission has granted the Utica Gas & Electric Company permission to operate the franchises granted by the village of Frankfort and the towns of Frankfort, German Flats and Little Falls, and to commence construction under them.

SMITHFIELD, N. C.—The Holmboe Company, of Louisville, Ky., has been engaged to prepare plans and specifications for water works, electric light plant and sewerage system for this town. As soon as an estimate of the cost is prepared an election will be held to vote to issue bonds for the work, and if bonds are voted, work will be started soon.

ASHBORO, N. C.—The Genton Lumber Company, recently incorporated, proposes to furnish electricity for lamps and motors in connection with its lumber plant. W. C. Hammer is interested in the enterprise.

CINCINNATI, OHIO.—W. Kelsey Schoepf, president of the Cincinnati Northern Traction Company, has petitioned for a lease on the bank of the Miami & Erie Canal, between Dayton and Miamisburg, for a pole line. It is said that he is planning to furnish electricity for lamps and motors to towns along the line.

COLUMBUS, OHIO.—Bids will be received until Nov. 25 by the Board of Public Service (E. F. McGuire, secretary) for furnishing material and making the following improvements at the municipal electric light plant, Dublin Avenue: Boiler blow-off tunnel, foundation for additional boilers, continuation of ash-pit tunnel, retaining wall and driveway, foundation for 1000-kw steam turbine and exciter and foundation for water-tight pit around foundations for turbine, etc.

McCONNELLSVILLE, OHIO.—The McConellsville-Malta Electric Company is contemplating the installation of gas engines of 150 hp to be used in case of emergencies. A. Durbin is superintendent.

MILFORD CENTER, OHIO.—The light and water plant, which was recently sold by the village to Dr. John L. Boylan, has passed into the hands of Edward Schambs, of Richwood, Ohio.

NEWCOMERSTOWN, OHIO.—The Newcomerstown Light, Heat & Power Company has increased its capital stock from $25,000 to $100,000.

BLACKWELL, OKLA.—The new municipal electric light plant and water works will be completed in about two months. H. H. Alexander is superintendent.

OKLAHOMA CITY, OKLA.—General Manager J. W. Shartel, of the Oklahoma City Street Railway Company, has announced that plans have been made for extensive improvements and extensions to the street railway in this city, which will involve an expenditure of about $1,000,000. Work has commenced on the construction of the interurban line to Edmond, 14 miles north of the city. It is the intention of the company later to extend the interurban line to Guthrie.

GRANT'S PASS, ORE.—The Gold Hill Canal Company is said to be carrying on negotiations to acquire the properties of the Gold Ray Water & Power Company, the Golden Drift Mining Company, the Savage Rapids water power, and the Hell Gate water power. The Gold Ray Water & Power Company owns a large electric plant at Gold Ray on the Rogue River, which supplies electricity to Grant's Pass, Gold Hill, Central Point, Medford, Jacksonville and Ashland, and also to a number of large mines in Southern Oregon, the longest of its lines being that to the Greenback mine, 42 miles in length. The Gold Drift Mining Company has a dam in the Rogue River near Grant's Pass and supplies power to operate two large pumps, the water being used for hydraulic mining. The Savage Rapids and Hell Gate power properties have not been developed, though among the most available on the Rogue River. Savage Rapids is five miles above Grant's Pass, and Hell Gate is 14 miles below. The Gold Hill Canal Company has its headquarters at Indianapolis, Ind. The company has a small electric power station at Gold Hill.

NEW PINE CREEK, ORE.—F. E. Russell, chief engineer of the California-Oregon Light, Heat & Power Company, writes that the power plant of the company was destroyed by fire on Oct. 11, and that the company has decided to install an entire new plant. E. Keller is president and manager.

ALTOONA, PA.—The Juniata Water Power Company has entered into a contract with the Citizens' Electric Light Company to supply the latter company with electricity for a term of ten years.

DELTA, PA.—The Delta Electric Power Company has closed a contract with the Ambursen Hydraulic Construction Company, of Boston, Mass., for the construction of a reinforced concrete dam in southeastern Pennsylvania to supply power to the slate quarries and other industries in that district. The dam will have a head of 65 feet, and the power house will be under the rollway of the dam and protected by an inner shell. Work has already commenced on the dam and it is expected to have it completed early in the spring.

HUNTINGDON, PA.—The dam of the Juniata Hydro-Electric Company has been completed and the plant will soon be started. Besides the dam, which will furnish 4000 horse-power, a large steam plant has been erected for generating electricity. The plant will furnish electricity for lighting Huntingdon and Altoona, and will also furnish the Wilson Electric Company with electrical power. The cost of the plant is estimated at about $2,000,000.

NORRISTOWN, PA.—The citizens, on Nov. 5, voted to issue $300,000 in bonds for the construction of sewers and roadways and for enlargement and extension of the municipal electric light plant and other purposes.

PITTSBURG, PA.—A permit has been granted St. Francis Hospital to construct a power house to cost $100,000 to furnish light, heat and power for the hospital.

PITTSBURG, PA.—The special committee of the Select Council, appointed to consider the ordinance requiring the placing of all public service wires underground, adopted a resolution requesting the Director of Public Works to furnish the Council with an estimate of the cost of building a conduit system covering the entire city, also plans and specifications of the same.

POTTSVILLE, PA.—At a recent meeting of the directors of the Edison Electric Illuminating Company and the Minersville Electric Light Company Heber S. Thompson was elected president of both companies. The Edison Electric Illuminating Company has greatly improved its system, and has made long-term contracts with various municipalities. The company has just completed its system for lighting in Orwigsburg and is now lighting the streets of the town in accordance with the contract recently made. Port Carbon will receive electricity for private and public consumption within a short time.

YORK, PA.—The McCall Ferry Power Company, which is building a large dam at McCall Ferry on the Susquehanna River, suspended operations Nov. 2, when the last of the force of 2000 men were laid off. The suspension is due to the closing of the Knickerbocker Trust Company. Charles T. Barney, former president of the Knickerbocker Trust Company, was the chief promoter of the McCall Ferry Power Company, and the trust company is trustee of the bond issue.

GANN VALLEY, S. D.—A telephone company is being organized to install a local exchange and build rural lines.

COVINGTON, TENN.—The Memphis, Covington & Northern Electric Railway Company has applied for a charter for the purpose of constructing an electric railway between Memphis and Covington. The company will be capitalized at $14,000, and the incorporators are C. B. Gillespie and John T. Garner.

LEBANON, TENN.—The Board of Mayor and Aldermen has granted the City of Cedar Mills a franchise to furnish electrical energy to all the manufacturing plants in the city. The company agrees to furnish electricity at the rate of four cents per kw-hour or less, and the city is to receive two per cent of the gross earnings of the company on all such contracts. The city recently contracted with the company to furnish electricity for operating the municipal electric lighting system for the next ten years. It is expected to have the plant in operation within 30 days.

AMARILLO, TEX.—The Amarillo Water, Light & Power Company is contemplating the complete rearrangement of its system and doubling the capacity of its plant. Frank W. White is secretary and manager.

DENTON, TEX.—H. M. Griffin, president of the Denton Interurban Railway & Power Company, has announced that the finances for the construction of the proposed interurban electric line have been arranged for.

FORT WORTH, TEX.—The telephone company is contemplating the construction of additional telephone exchanges in North Fort Worth and the south side to supplement the main building in Fort Worth.

GOLIAD, TEX.—Work has commenced on the construction of an electric light plant in Goliad. Dr. W. L. Chilton is interested in the enterprise.

NEW BRAUNFELS, TEX.—The Landa Electric Light & Power Company is installing a 35-hp motor to operate the Landa elevator. C. C. Platz is superintendent.

SAN ANTONIO, TEX.—The City Council has granted a franchise to the San Antonio Traction Company to extend its Tobin Hill line to one of the suburbs. W. B. Tuttle is vice-president and general manager.

SAN ANTONIO, TEX.—Charles Smith, of San Antonio, is interested in the construction of an electric interurban railway between New Braunfels and Seguin, a distance of fifteen miles. Water power rights have been secured on the Guadalupe River for operating the proposed water plant.

BETHEL, VT.—The Woodbury Granite Company has commenced the construction work on an extensive addition to its cutting plant. The new plant will be equipped throughout with the latest machinery, which will be operated by electricity. The cost of the improvements is estimated at from $75,000 to $100,000.

MORETOWN, VT.—This town will soon be lighted by electricity. The main line of the Moody & Almon system running to Northfield has been tapped about two miles from the village and many of the stores and residences have been wired. R. F. Britain, of Montpelier, who has had charge of the construction of the system, is to be resident engineer.

RANDOLPH, VT.—The White River Electric Company has entered into an arrangement with the Gaysville Power Company whereby the latter company will furnish power for operating the electric lighting system in this village. The Gaysville Power Company has a power plant on the White River which has a capacity of 500 hp. The company furnishes power for the Woodbury Granite Company and the Woodbury stone sheds, where the steam plant will be located, which will be used as an auxiliary in times of low water.

BUENA VISTA, VA.—The Buena Vista Light & Power Company is contemplating installing a new switchboard in its plant and making other improvements.

LYNCHBURG, VA.—C. W. Hancock & Sons, of this city, have secured the contract for the construction of a concrete dam across Cedar Creek on the Natural Bridge property. The dam will be located a half mile below the bridge and will furnish power for an electric plant of 1000 hp. The plant will furnish electricity for lighting the grounds and charging automobiles, which will be used to convey visitors around the grounds. C. I. Johnson is president of the company owning the grounds.

FRIDAY HARBOR, WASH.—Arrangements have been made whereby the streets of the town will soon be lighted again by electricity. The mill in which the dynamo was formerly installed has been sold to the Templin Brothers, and the machine is now being placed in the mill. The dynamo was removed from the mill the day before the local bank foreclosed on the mill property, and since that time the citizens have been forced to use oil lamps.

PORT TOWNSEND, WASH.—The Pacific Electric Company is making preparations to install electric lighting plants in the Fairmount shingle mill, owned by Lundstrom & Fischer, and in the Diamond shingle mill at Center.

PROSSER, WASH.—The Prosser Traction Company, recently organized to construct an electric railway in this section, is preparing to file an application for a power right on the Yakima River. Frederick Finn, representing the company, has announced that the company had selected a site seven miles below Prosser, which if secured the company will construct a dam and build a power house and transmit electricity to Prosser. The traction company now holds two franchises, one from this city, and one from Benton.

STEVENSON, WASH.—H. C. Eckensberger, of Portland, Ore., general freight agent of the New York Central Lines, writes that it is proposed to utilize the water power of the Upper Cascade Rapids for manufacturing and other purposes.

BLUEFIELD, W. VA.—The Bluestone Traction Company will soon commence construction work on its South Bluefield extension to Ghent. The rails, poles, wires, etc., have already been purchased. Surveys have also been completed for the Princeton extension, which will be twelve miles in length. P. M. Wallizer is general manager of the company.

ELKINS, W. VA.—The Elkins Electric Railway Company has been granted a franchise by the county court to construct and maintain an electric railway on the county roads in Leadsville, Roaring Creek and Beverly districts.

WHEELING, W. VA.—It is understood that the National Telephone Company will soon make application to the county courts for permission to place its wires underground along the county road through the Narrows through Glendale.

MADISON, WIS.—The Wisconsin Capitol Commission will receive separate proposals until Nov. 22 for furnishing the equipment for the heating and power plant for the capitol building now under construction at Madison, as follows: Boilers, engines, electrical generators and motors, mechanical stokers, feed pumps, building supply pumps, storage tanks, conveying machinery, hoisting crane and open heaters. Specifications and blank forms may be obtained from Lew F. Porter, secretary of the Capitol Commission.

MARINETTE, WIS.—A. W. Wilson, of Marinette, and A. L. Gillette, of Oconto, have applied to the City Council for a franchise to establish a new lighting system for the city of Marinette. The petitioners offer to furnish electricity for lighting purposes for one-half of the present rate, and also state that they intend to start an interurban railway from Marinette to Peshtigo. Electricity for operating the system will be secured from the water power of the Perley Lowe Company on the Peshtigo River.

NORTH MILWAUKEE, WIS.—The North Milwaukee Light & Power Company is contemplating changing part of its system to alternating current. Theodore Waech is manager.

WAUWATOSA, WIS.—The citizens are considering the question of establishing a municipal electric light plant.

CHEYENNE, WYO.—The Big Horn Power Company, which was recently incorporated with a capital stock of $700,000, proposes to supply central Wyoming with electricity for lighting and power purposes. The company is planning to construct a dam on the Big Horn River, fourteen miles from Shoshoni. The plant will have a capacity of 10,000 horse-power, and will furnish the Boysen Mining Company with 500 horse-power, and the remainder will be distributed among the towns within a radius of 100 miles. Among the towns to be supplied are Lander, Shoshoni, Thermopolis, Riverton and Arapahoe. Ultimately the company intends to connect these towns with an electric railway.

OKOTOKS, ALB.—The Okotoks Electric Light & Power Company closed its plant on Nov. 1, and has notified the Town Council that it will be sold to the first purchaser, as it has been run at a loss since its inception.

STRATHCONA, ALB.—The ratepayers voted in favor of granting a franchise to the Strathcona Radial Tramway Company, which was organized for the purpose of building an electric street railway system here. The company has already made application to lay tracks on several of the streets in the city of Edmonton.

BRANDON, MAN.—An electric lighting plant installed at the water works has proved so successful that the Council is considering the installation of a plant to do all the municipal lighting. Address Superintendent Shaw.

MINNEDOSA, MAN.—Surveys have been completed for the development of a municipal power plant here, and arrangements are now being made for the calling of tenders. Address E. O. Dennison.

SOURIS, MAN.—At a meeting of the Town Council the clerk was instructed to write D. A. Keiser, Winnipeg, Man., regarding the construction of a dam in the Souris River for the ultimate development of electrical power. Address Alderman Stirling, Souris.

LONDON, ONT.—The City Council has decided to adopt the report of the special power committee recommending the submitting of a by-law to the people on Jan. 6, 1908, calling for $235,000 for the construction of a distributing plant for the city for Niagara power, and providing for new street lamps and equipment. Engineer Richards submitted an estimate on the lighting end of the proposition which has not been included in the previous report, which will require an additional sum of $135,000.

STAMFORD, ONT.—The township of Stamford has completed arrangements for lighting its main highways by a private corporation allied with the Ontario Power Company. The municipality will pay the company $500 a year for lighting the roads from Niagara Falls to a point known as Stamford, a distance of three and a half miles, and from Stamford for two miles along the Lundy's Lane Road. Incandescent lamps will be used on these highways. Many residents along the road have contracted with the company to furnish electricity for lighting.

TORONTO, ONT.—Surveys have been completed which the Hydro-Electric Power Commission has been making with a view of obtaining routes for transmission lines from Niagara Falls. Surveys have been made from Niagara Falls to Toronto, Niagara Falls to Hamilton, to London, via Woodstock, and to London via Berlin, Stratford and St. Mary's branches; also to St. Thomas, to Preston and Galt. The routes which have been laid out would practically give a double line of wires and obviate any danger of lack of service by reason of accidents to the transmission lines.

TWEED, ONT.—A transfer has been made of the plant of the Tweed Electric Light & Power Company to J. T. Kissack, who, together with his brother, is proprietor of the Paisley Electric Light Company, Paisley, Ont.

WALKERVILLE, ONT.—Extensive improvements are being made to the electric plant owned by Hiram Walker & Sons, Ltd. The company is now installing a 150-kw, 2200-volt, 2-phase Westinghouse generator direct connected to McEwen engine, made by the Waterous Engine Company, of Brantford, Ont.

New Industrial Companies.

THE WESTERN MULTIPHONE COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000,000.

THE ASUNCION CITY IMPROVEMENTS, ELECTRIC LIGHT, POWER & TRAMWAYS COMPANY, of Portland, Me., has been incorporated with a capital stock of $3,000,000, for the purpose of conducting a general construction business. James E. Manter is president of the company and Clarence E. Eaton is treasurer, both of Portland.

Legal.

POWER OF CITY TO REGULATE TELEPHONE RATES.—A city authorized to fix and regulate telephone rates granted a franchise under the statutes of California, providing for the sale of franchises, under which a telephone company was given the right for a period of fifty years to construct, maintain and operate a telephone line. The ordinance fixed the charge not to exceed $60 per annum for private telephones until the exchange comprised more than 10,000 telephones, after which the rate should not be increased by more than a sum equal to $6 per annum for each 1000 telephones connected in excess of the 10,000. In consideration for this franchise, the telephone company furnished thirty telephones to the city gratis, and also provided fifty pairs of wires in its conduits and the upper arms of its poles for the use of the city's police and fire-alarm telegraph system, and agreed to pay a 2 per cent gross earnings tax. It was held that the city by such ordinance did not surrender its right to regulate rates for the 50-year term of the franchise, but that the city was entitled to reduce the rates below the maximum charge so fixed during the term of the franchise. It was contended by the telephone company, in an action to restrain the enforcement of an ordinance which lowered the rate, that the power conferred was only a power to fix and determine charges once for all; that is, permanently, by contract, but the contention was not sustained and its was held that the words themselves, "fix" and "determine," when applied to rates, fairly import a continuing power of regulation. Home Telephone & Telegraph Company vs. City of Los Angeles, United States Circuit Court, Fed. Rep. 554.

LIABILITY OF TELEPHONE COMPANY FOR DEATH OF EMPLOYEE.—A lineman in the service of the Cumberland Telephone & Telegraph Company went out with others to push back into a perpendicular position a pole on the line of the company which had leaned over from a heavy sleet. The pole carried a large number of wires and was about 45 feet high. The telephone wires were up near the top; and down about 30 feet from the ground there ran a high-voltage circuit of an electric light plant. When they had dug the earth out around the foot of the pole and attempted to push it back to a vertical position it was found that it came in contact with the electric light wire. As it was raining, the pole and the electric light wire were wet, and when the pole came in contact with the wire the pole began to smoke. The foreman determined to place an insulator on the pole and fasten the electric wire to it, and the lineman was directed to do the work. While he was working he received a shock from which he died. It was held that the company was liable in damages, and a verdict of $10,000 was awarded. The lineman had not assumed the risk incident to insulating the wire. The servant assumes the risk ordinarily incidental to his work, conducted with ordinary care; but he does not assume risks due to the negligence of the master, of which he has no knowledge, and which are not so obvious that by ordinary care in the discharge of his duties he should know them. It is the duty of the master to furnish the servant a reasonably safe place to work, and reasonably safe appliances for performing his work; and the servant, in performing his duties, where inspection is not in the line of his duty, has the right to assume that the place and the appliances are reasonably free from danger, and to act upon the assumption, unless he knows of the danger, or by ordinary care in the discharge of his duty he should know of it. In cases like this the burden is on the defendant to show that the employee took the risk with the knowledge of the danger, or that he failed to use ordinary care for his own safety, but for which he would not have been injured. Cumberland Telephone & Telegraph Company vs. Graves, Court of Appeals of Kentucky, 104 S. W. Rep. 357.

Obituary.

MR. H. F. BENDER.—Mr. Harry F. Bender, treasurer of the Gamewell Fire Alarm Telegraph Company, of New York City, was taken suddenly ill last week when he was leaving a Mount Vernon train at the Grand Central station. He was removed to the station master's office and died shortly afterward.

MR. C. D. WYMAN.—The sudden death is announced of Mr. C. D. Wyman, of Boston, in a railway train in Montana while on his way from Boston to Seattle. He was looking after the interests of the Stone & Webster Corporation in that region. Mr. Wyman was widely known in the electric railway field, having been connected with enterprises in New York City, Milwaukee and New Orleans, and taking an active part in street railway association matters. He was 57 years of age and leaves a wife and three daughters.

Personal.

MR. W. EDGAR REED.

MR. W. EDGAR REED, electrical engineer, formerly with the Westinghouse interests in Paris for some time, and also for a considerable time at East Pittsburg, has opened an office for general consulting work in the Machesney Building, Pittsburg, Pa. Mr. Reed entered the employ of the Westinghouse Electric & Manufacturing Company in 1891 as an engineering apprentice. Upon finishing his apprenticeship course in the Westinghouse works he took a course in the Massachusetts Institute of Technology, from which he was graduated in 1897. Later he took a post-graduate course in Paris at the laboratory of the late Prof. Henri Moissan, the well-known chemist and metallurgist. Following this Mr. Reed became connected with the French Westinghouse Company at Havre, France, filling the position of chief designing engineer of that company from 1898 to 1903. In 1903 Mr. Reed went to Pittsburg, filling the position of designing engineer for the French and American Westinghouse companies. This position he has filled up to this time. He has had a long experience in designing both continuous and alternating current machinery, and has had direct charge of induction motor designing for several years. He has also had much experience in the practical application of direct and alternating current motors and generators, and is thoroughly familiar with their characteristics and applications. Mr. Reed is a member of the American Institute of Electrical Engineers, and also of the Engineers' Society of Western Pennsylvania. He is a nephew of Mr. Albert Schmid, so long associated with the Westinghouse engineering and manufacturing departments.

MR. JOHN E. BRADY has associated himself with Alfred W. Varian, Esq., in the general practice of law, with offices at 44 Pine Street, New York.

MR. GUY P. WRIGHT, formerly of South Framingham, Mass., has accepted the position of chief engineer of the municipal electric light plant in Holyoke, Mass.

MR. W. E. HASELTINE, superintendent of the Dexter Electric Light Company, Dexter, Me., has resigned, and will leave for Raleigh, N. C., where he has accepted a similar position.

MR. ALEX. HENDERSON, of the American Circular Loom Company, is on a long Western trip and reported recently from Billings, Mont. He finds good conditions and prospects in that section of the country.

MR. EDWARD E. SCRIBNER has joined the staff of the Holophane Company, with headquarters in New York. Mr. Scribner's work will lie in interesting architects in modern methods of illumination.

COL. M. E. THORNTON, of Hickory, N. C., the president of the Thornton Light & Power Co., president of the Water-Power Electric Co., which is just ready to be developed, and also the contemplated street railway, desires the services of a competent man to manage the entire business for him, and one who can assist him in the financing of the water-power electric enterprise at once.

DR. C. P. STEINMETZ is delivering at the Polytechnic Institute, Brooklyn, a series of eight lectures on light, radiation and illumination. The term is from Nov. 7 to March 12, and the fee for the course is ten dollars.

MR. HUGH C. MACLEAN, of Toronto, Canada, well known as a technical and trade publisher, has purchased the *Canadian Electrical News*, which he proposes to bring up to the level of his other enterprises in modernity and efficiency.

MR. C. O. BAKER, JR., has been on a visit to Kansas and was last heard of at Wichita. While there he posed as the "Platinum King," and was rated by the papers as "many times over a millionaire." The impecunious East is awaiting his return eagerly.

MR. THOMAS NEWHALL, West End Trust Building, Philadelphia, has sold his interest in the firm of J. L. Blackwell & Company, and the construction company, Newhall & Company, has been dissolved. He is now devoting his attention to the purchase and sale of the securities of well-established electric railways.

MR. G. MARCONI has sailed from Canada for England. A dispatch from Glace Bay says: "While occupied chiefly at Glace Bay in the perfection of his newly inaugurated service of transatlantic wireless telegraphy, Mr. Marconi announces he is giving considerable thought to the employment of Hertzian waves for the transmission of power as well as a means of communication."

MR. H. W. CONNELL, of the firm of Connell, Sykes & Connell, engineers, 90 West Street, New York, has recently been retained as consulting engineer to the Hannawa Falls Power Co., of Potsdam, N. Y. Under his supervision the company is making large additions to its equipment and extending its transmission lines. Mr. Connell will spend a large part of the coming winter at Potsdam, giving this work his personal attention.

PROF. ROBERT SIBLEY, professor of mechanical and electrical engineering at the University of Montana, has resigned his chair in the university in order to devote himself exclusively to engineering consulting practice, with offices in Missoula. Electrical and hydraulic work will be made specialties. Mr. Nathaniel P. Craighill, formerly with the Mechanical Appliance Company, Milwaukee, and a graduate of Massachusetts Institute of Technology of the class of '93 has, as recently announced in these columns, been elected to the chair of mechanical and electrical engineering.

MR. M. J. BUDLONG.—Two important annual meetings of two of the largest automobile trade associations were held last week, the Association of Licensed Automobile Manufacturers, under whose auspices the Madison Square Garden show was held, and the National Association of Automobile Manufacturers. The Licensed Association met at its offices, and the most important act was the retirement of E. H. Cutler as general manager and the election of Milton J. Budlong to the position. Mr. Cutler will hereafter devote his entire attention to the Knox automobile concern, with which he has been identified for several years. Mr. Budlong was formerly president of the Electric Vehicle Company, of Hartford, but resigned a short time ago. He is one of the best known men in the automobile world.

MR. H. L. HIBBARD, electrical expert to the Bureau of Construction and Repair, U. S. Navy Department, has resigned that position to enter the employ of the Cutler-Hammer Manufacturing Company, of Milwaukee, makers of electric controlling devices. Mr. Hibbard's experience in navy yard and shipboard work extends over a period of eight years, four of which were spent in the office of the superintending naval constructor at Newport News, in supervising installations of electrical apparatus on ships built and equipped at that yard. More recently Mr. Hibbard has been stationed at Washington where, as electrical expert to the Bureau of Construction and Repair, he has had supervision of all electrical work coming under the cognizance of that bureau. In his new position with the Cutler-Hammer Company, his thorough knowledge of navy requirements and methods will undoubtedly be of great value in the further extension of that company's line of electric controlling panels for navy yard and shipboard use.

Trade Publications.

DEAN ELECTRIC COMPANY, of Elyria, Ohio, has issued a neat pamphlet entitled, "An Independent Telephone Plant," and descriptive of its fine new factory and its equipment. The company has increased its plant three times in three years. The power plant includes two Stirling boilers, two Ball cross-compound engines and two Crocker-Wheeler direct-current generators of 200 kw each. The various shops are driven electrically.

THE CENTRAL ELECTRIC COMPANY, Chicago, is sending out a number of attractive circulars calling attention to the various types of Columbia lamps. The company reports a very much increased business this year in Columbia lamps as compared with any previous year in its history, and confidently asserts that this increased business is due entirely to the many superior qualities of the Columbia. The Central Electric Company asks that those who contemplate buying incandescent lamps in the near future should communicate with it.

LIFTING MAGNETS.—The Cutler-Hammer Clutch Company in a handsome 32-page catalogue describes and illustrates its line of lifting magnets for handling pig iron, steel stampings, castings, scrap and other material. Several full-page illustrations show magnets lifting great burdens, and diagrams are given showing the principles of construction. A new cable take-up device is illustrated and described, by which the strong inductive reaction which occurs when the circuit is suddenly opened on a magnet coil is automatically shunted to discharge resistance, thus protecting the lifting coil.

Business Notes.

THE FERRACUTE MACHINE COMPANY, of Bridgeton, N. J., manufacturer of presses and dies for sheet metal work, made shipments of its presses last month to India, Austria, France and England, besides several carloads of large presses to manufacturers of electrical goods in this country. Its shops are provided with electric cranes and installed with modern machinery, placing the company in a position to handle large orders.

THE NORTH SHORE ELECTRIC COMPANY, of Beverly, Mass., has taken over the business of the Greenlaw Electric Company, of Beverly, Mass. Joseph W. Lee retires from the company and Joseph M. Greenlaw will manage the Beverly store, and his district will cover Beverly, Salem, Wenham and Hamilton. The North Shore Company has also taken over the business of Charles C. Phillips, in Lynn. John Andrews, of Gloucester, is treasurer and general manager.

J. L. SCHUREMAN COMPANY, manufacturer of electric motor controlling devices, whose main office is at 70 to 86 West Jackson Boulevard, Chicago, Ill., has recently moved its New York office to 114 Liberty Street, where its interests will be looked after by Mr. W. R. Harvey. This move increases the facilities which this company has enjoyed in New York, and places it in an excellent position to bid on all work without regard to location of the project.

THE WIRE & TELEPHONE COMPANY OF AMERICA recently purchased the entire equipment and stock of the Reed Electric Cordage Company, of Syracuse, N. Y. This additional equipment gives the Wire & Telephone Company a manufacturing capacity which enables it to take care of its rapidly growing demand, not only for bare copper wire, magnet wire and rubber covered wire, but all grades of weatherproof, office, fixture and annunciator wire. The well-established trademark "Romeoid" is a guarantee of quality and has given this progressive company an excellent standing in the trade. The fact that it draws the wire for its insulating departments insures a conductor in the insulated product perfect in every respect.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOV. 5, 1907.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

869,873. INSULATOR; Duncan M. Bass, Fackler, Ala. App. filed June 17, 1907. An insulator comprising a vertically slotted casing having an insulating block therein transversely recessed to receive a conductor opposite said slotted portion of the casing.

869,885. SIGNAL BELL; George F. Drew, Brunswick, Me. App. filed Oct. 13, 1906. The bell is specially formed with laterally extending portions between which the clapper can vibrate.

869,914. ELECTRIC ARC LAMP; George M. Lane, Lanoka, N. J. App. filed March 24, 1905. Details of gravity-feed controlling mechanism for an arc lamp including a compound lever arrangement connected to the clutch.

869,934. DYNAMO ELECTRIC MACHINERY; Charles A. Parsons and John H. Armstrong, Newcastle-upon-Tyne, England. App. filed Feb. 10, 1906. A compensating winding for field magnets including pole pieces with grooves in their face parallel to the axis of the machine and adapted to contain flanged elements of magnetic material.

869,943. ALTERNATING-CURRENT MOTOR CONTROLLER; August Sundh, Yonkers, N. Y. App. filed Dec. 18, 1905. Motor-controlling apparatus for elevator hoists including features by which the contactors are successively operated through a pilot circuit by pneumatic operation.

869,955. SWITCH FOR TROLLEY WIRES; Frank M. Zimmerman, Aurora, Ill. App. filed Oct. 23, 1905. At a trolley turn-out patentee provides a movable double-conductor element which swings into alignment either for the direct track or the turn-out.

869,970. RAILWAY SIGNAL AND SAFETY APPLIANCE; Charles J. Kintner, New York, N. Y. App. filed Aug. 10, 1905. Includes mechanical features and electrical circuits of a signal system having among other features a train stop lever on the roof of the car, which is engaged by an arm from the semaphore signal.

870,002. CABLE SUSPENSION DEVICE; Malcolm C. Williams, Kansas City, Mo. App. filed Oct. 3, 1906. A wire is bent into special form so as to engage a messenger wire and support a cable so as to be removable without the use of special tools.

870,015. STORAGE BATTERY; Joseph C. Cook and Edward Sokal, Buffalo, N. Y. App. filed May 10, 1905. Storage battery plate in which the lead has a multitude of very slender cones which serve to hold the active material in place.

870,029. SYSTEM OF MOTOR CONTROL; Jay H. Hall, Cleveland, Ohio. App. filed March 19, 1906. System for controlling one or more electric motors from a distant point. A motor has a magnetically operated switch and an auxiliary switch mechanically opened by the closure of the main switch.

870,035. DYNAMO ELECTRIC MACHINE; Dugald C. Jackson, Madison, Wis. App. filed Dec. 22, 1902. Provides a single-phase, alternating-current generator adapted to be self-starting. Form of a series commutator motor with a starting resistance in the circuit.

870,042. RESISTANCE ADJUSTING DEVICE; Hector P. MacLagan, Chicago, Ill. App. filed Oct. 11, 1905. Has a resistance winding circularly disposed in the path of a pivoted arm which makes contact with the windings throughout its arc of movement.

870,068. FIRE ALARM; Robert M. Whipple, Mayfield, Idaho. App. filed June 19, 1907. A thermostatic alarm in which an electric signal circuit is closed by the expansion of metal under the action of heat.

870,078. ELECTRIC SWITCHING APPARATUS AND CONTROLLING APPARATUS THEREFOR; Alfred Blackmore, Kensington, London, England. App. filed April 2, 1906. Provides a magnetic switching apparatus working with low voltage currents for controlling high-voltage switch at a distance. Has a ratchet mechanism to obtain the successive alterations in opposite directions.

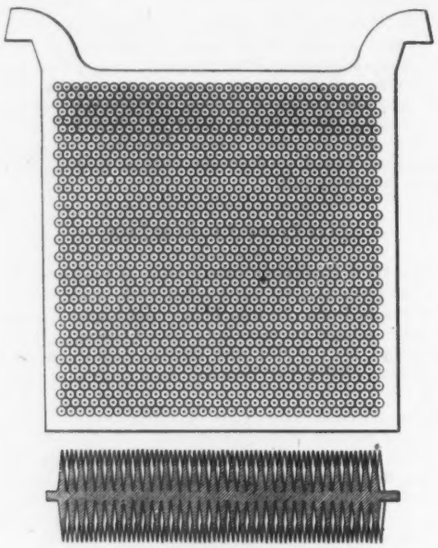
870,080. TROLLEY WHEEL; Charles P. and Homer C. Bostian, Milton, Pa. App. filed July 15, 1907. The peripheral groove of the trolley wheel is inset with V-shaped spurs for breaking up ice on the conductor.

870,102. ELECTRIC SIGNALING APPARATUS; Felix B. Herzog, New York, N. Y. App. filed July 12, 1889. Form of circuit closure which will produce changes in the normal circuit conditions at its station which will continue until some act is performed at a distant point.

870,139. TRACK RELAY; John D. Taylor, Swissvale, Pa. App. filed April 18, 1907. An alternating-current relay in form of a wattmeter which operates at only one frequency. The rotation makes contact through a centrifugal device.

870,141. AUTOMATIC STARTING DEVICE FOR ALTERNATING-CURRENT-VAPOR LAMPS; Carl H. von Baur, New York, N. Y. App. filed April 16, 1907. Alternating-current mercury-vapor lamp having a pair of positive main electrodes, a negative main electrode, positive and negative auxiliary electrodes and means for rocking the two.

870,145. ELECTRIC SIGNALING SYSTEM FOR RAILWAYS; Harry J. Warthen, Washington, D. C. App. filed Jan. 18, 1907. Among other features of a signal system, patentee has a specially constructed contact shoe in the form of a downwardly spring-impelled pivoted arm.

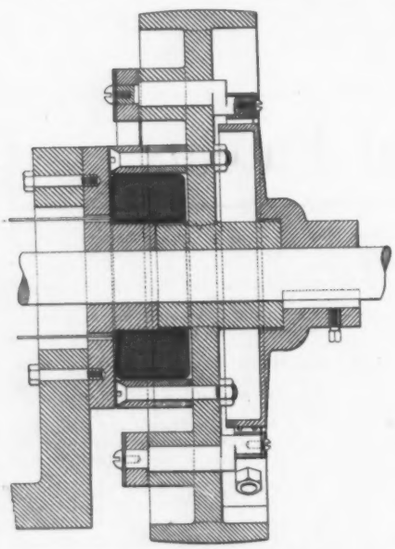


870,015.—Storage Battery.

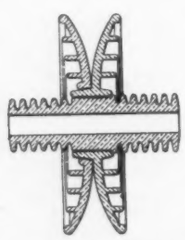
870,147. MULTIPLE UNIT CONTROLLING SYSTEM FOR ELECTRIC LOCOMOTIVES OR MOTOR CARS; Ragnar Wikander, Westeras, Sweden. App. filed Jan. 5, 1907. System for controlling the speed of trains having two or more electric locomotives. Has means whereby the respective voltages supplied to the motors of each unit may be independently regulated.

870,149. SYSTEM OF ELECTRICAL DISTRIBUTION; Joseph L. Woodbridge, Philadelphia, Pa. App. filed April 19, 1905. Relates to systems in which use is made of a battery and its booster in connection with both alternating-current and direct-current lines.

870,150. SYSTEM OF ELECTRICAL DISTRIBUTION; Joseph L. Woodbridge, Philadelphia, Pa. App. filed May 21, 1907. Relates to systems of distribution in which there is an alternating-current and a direct-current circuit, with means for transmitting energy in either direction between the two. Designed to provide more sensitive means for automatically effecting such transmission, and for controlling the power effect on the alternating-current circuit.



870,166.—Electric Clutch.



870,187.—Wall Insulator.

870,166. ELECTRIC CLUTCH; Noah S. Harter, Waukegan, Ill. App. filed June 25, 1907. Clutch having a driving and a driven member connected by friction straps, and electromagnetic means carried by a third stationary member and adapted to tighten said straps.

870,168. INTERCOMMUNICATING TELEPHONE; W. W. Henry, Wollaston, Mass. App. filed Sept. 17, 1906. A formed metal telephone box comprising a base, a body rigidly secured to said base and a two-part cover removably secured to said body and adapted to support the transmitter; in combination with a bell movement, induction coil, receiver switch, signaling switch and necessary connectors, all removably secured within said body.

870,169. APPARATUS FOR MAKING RAIL BONDS; Albert B. Herrick, Ridgewood, N. J. App. filed May 5, 1904. An apparatus for making rail bonds comprising a block having a raised surface about which a conductor is adapted to be wound and having slots dividing such surface into a plurality of parts through which the conductor is cut to make two separate bonds.

870,187. WALL INSULATOR; Fred M. Locke, Victor, N. Y. App. filed July 18, 1907. Wall insulator for high-potential currents having ribbed cylindrical portions projecting on either side of the wall and separated therefrom by flaring petticoats.

870,198. ELECTRICAL HORN; William E. Russell, Danbury, Conn. App. filed Sept. 28, 1906. Electrical horn having a magnet operated vibrating diaphragm.

870,211. EVAPORATOR; Edward Zaremba, Chicago, Ill. App. filed March 12, 1906. An apparatus for evaporating corrosive liquors comprising a receptacle having a refractory lining and non-corrodable electrodes which extend below the liquid level. Has conductors connected to said electrodes and supported entirely above the liquid level.

870,232. SIGNALING DEVICE FOR RAILWAYS; George S. Getschell, Los Angeles, Cal. App. filed Jan. 24, 1907. Railway signal having a plurality of features including depressible tappets adjacent to the track rail which are impelled to close the signal circuits by the wheels of a passing train.

870,233. PROCESS OF MANUFACTURING REFLECTOR INCANDESCENT LAMPS; Howard Gilmore, Brookline, Mass. App. filed Aug. 16, 1905. The lamp is manufactured with a reflector permanently embodied within the globe.

870,253. ELECTRIC COMPENSATOR; Edmund O. Schweitzer, Chicago, Ill. App. filed Nov. 2, 1904. Means for automatically correcting the errors caused in electric instruments by internal and external variations of temperature. Includes a compensating element acted on equally by the temperature of the room or instrument.

870,262. THERAPEUTIC LAMP; Julius B. Wantz, Chicago, Ill. App. filed March 9, 1907. A concave casing has a plurality of separate lamps with individual parabolic reflectors and having their circuits separately controllable by plugs and jacks.

870,313. DYNAMO ELECTRIC MACHINE; Mathias Pfatischer, Philadelphia, Pa. App. filed July 23, 1906. Features of construction and arrangement of a magnetic circuit of a commutating field for alternating-current motors.

870,326. ELECTRIC FURNACE; Frank J. Tone, Niagara Falls, N. Y. App. filed March 7, 1905. An electric resistance furnace having a self-sustaining resistance conductor composed of shaped pieces of resistance material assembled to form a continuous electrical conductor.

870,328. ELECTRIC SIGNALING MECHANISM; Jean F. Webb, Jr., Chicago, Ill. App. filed May 31, 1907. Has a step-by-step unidirectional rotatable shaft carrying an escapement wheel and a ratchet disc and constituting a selecting mechanism whereby a particular signal of a line may be operated.

870,341. INCANDESCENT LAMP; Herman Boehm, Youngstown, Ohio. App. filed Nov. 21, 1906. An incandescent lamp bulb of cylindrical formation throughout the remaining portion of its length flattened at opposite points, the flattened portions extending from one end of the bulb to and terminating at the cylindrical portion, and leading-in wires flattened against the flat sides of the bulb.

870,353. CIRCUIT CLOSER; Theodore M. Foote, Allston, Mass. App. filed Nov. 3, 1906. Has two substantially similar toothed wheels secured together and having their teeth slightly displaced from one another. One is of insulating material whereby a contact engages the other only after a slight angular interval corresponding to the displacement.

870,376. CONTACT GALVANOMETER; John W. Manley, New Barnet, England. App. filed Sept. 29, 1906. Electric indicating apparatus having a pair of conductors belonging to two distinct circuits and twisted on each other, said twisted conductors being coiled around the field of play of a magnetized needle.

870,423. ELECTRICAL THERMOSTATIC ALARM; Joda Finch, Lynd-hurst, N. J. App. filed Feb. 26, 1907. A thermostat adjustable to operate at any predetermined temperature; has a form of mechanical thermometer with an adjustable contact in the path of the pointer.

870,471. CONNECTING DEVICE; George A. Schnaufer and Harry G. Smock, Denver, Col. App. filed July 7, 1906. Relates to electrical connections and more particularly to a connecting device for telephone and electric lighting wires by which tapped connections are quickly made with the usual service lines.

870,486. CONDUCTING WIRE SUPPORT AND INSULATOR; Harvey W. Wistner, Ogden, Utah. App. filed June 13, 1906. A two-part insulator in the form of a split sleeve which can be placed upon a wire so as to surround the same. It is exteriorally threaded so as to enter openings in the telegraph pole cross-arms.

870,490. COMBINED ELECTRIC CONNECTOR AND SWITCH; Stephen F. Burbank, Wilmington, N. C. App. filed Jan. 24, 1906. A revoluble contact device comprising two sets of insulated conductors, the conductors of one set having sockets receiving projecting portions of the conductors of the other set, said sets of conductors being relatively revoluble to each other through 360 degs.

870,495. AUTOMATIC RESOLDERING DEVICE FOR ELECTRICAL PROTECTIVE APPARATUS; Frank B. Cook, Chicago, Ill. App. filed May 11, 1907. A repairing device for thermal protectors of the character described, comprising two pairs of normally separated spring members, means for normally holding the pairs of spring members in this separated relation, and a thumb-piece adapted to be depressed whereby the contact between each pair of spring members is closed.

870,505. APPARATUS FOR SYNCHRONIZING MOTORS; Willard P. Gerrish, Cambridge, Mass. App. filed Jan. 23, 1905. An apparatus for synchronizing motors for the driving mechanisms of telescopes at remotely situated points.

870,518. PROCESS OF PRODUCING CARBON TETRACHLORID; Frederick J. Maywald, New York, N. Y. App. filed Oct. 6, 1902. The process of forming a chlorid of carbon which consists in contacting incandescent carbonaceous material with a stream of chlorin, removing the products of reaction from the point of formation and condensing the same.

870,530. INDIVIDUAL PROTECTOR UNIT; Frank B. Cook, Chicago, Ill. App. filed Feb. 11, 1907. An individual protector, comprising a sheet-metal base, insulating portions secured to one side of the said base, spring members carried by the said insulating portions and inserted through holes therein, and suitable fuses and lightning arresters held in place by the said spring members.

12,715. ELECTRICAL ATTACHMENT FOR MOVABLE OBJECTS; John R. Dawkins, Dallas, Tex. App. filed Sept. 30, 1907. Patentee connects the blade of his plow in an electric circuit for the stated purpose of preventing the soil from adhering thereto.